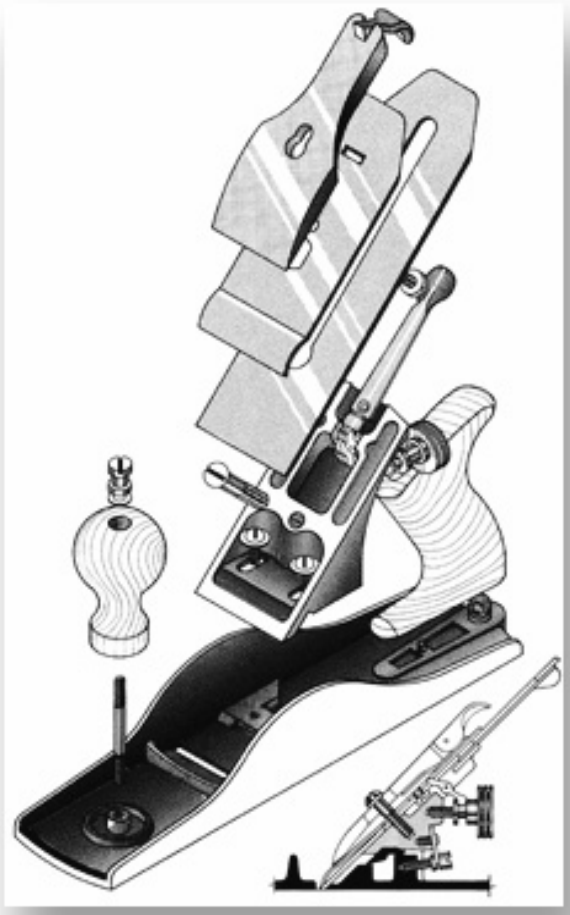
Carpentry - Housing

Introduction to Trade



NEW SOUTH WALES DEPARTMENT OF EDUCATION AND TRAINING
TAFE NSW
CONSTRUCTION AND TRANSPORT DIVISION

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INTRODUCTION TO TRADE

This text introduces a variety of subject matter related to Building and Construction, at a basic level.

It should be read in conjunction with "Basic Building and Construction Skills", produced by TAFE and Addison Wesley Longman Australia Pty Limited, as between them they address the following:

Details relating to the background of the Building and Construction industry outlining the structure, content and occupational health and safety aspects related to site activities;

Basic Carpentry and Joinery hand tools are introduced and explained, including methods of use and maintenance of the tools;

Plan interpretation, formal drawing and basic calculations are introduced to provide the background knowledge required to identify structural building elements, methods of detailing and how quantities and costs of specific materials are arrived at;

A comprehensive 'Glossary of Terms' is included at the end of the Unit which provides a detailed description of trade terms, technical content and some trade jargon.

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MEASURING, MARKING, HOLDING AND CUTTING HAND TOOLS

Accuracy is essential when setting out, and during the construction, of any object or construction element, therefore the setting out of lines and working to them is critical if the finished product is to finish as it was designed. The set out lines must be clear, jobs must be held firmly and sharp quality cutting tools used, to allow for working to the exact millimetre to take place. Therefore, selection of the correct tools must be made for the job as follows;

MEASURING TOOLS

Four-fold Rule

The woodworkers rule is usually made from either boxwood, white or coloured plastic, and brass or stainless steel pinned hinges or knuckles. When fully opened, ie. when all four leaves are extended, it measures exactly 1.0m long. The faces are marked in increments of 1mm, every 10mm and also every 100mm. Some rules have metric along the inside face and imperial along the outside face. The rule is made to fold up to make it easier to carry and less likely to be broken.

It is held with it's edge on the work so that the markings on the rule may be transferred accurately with a sharp pencil. It may be used for small joinery jobs, setting out spacings for studs, joists or rafters, setting out locks and hinges. It may also be used for gauging parallel lines, when held against the edge of the material, using a pencil to scribe the line.

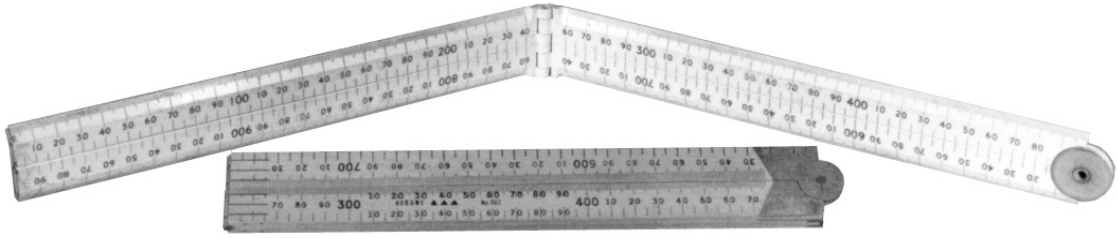

Fig 1 Four-fold rule

Tapes

The Retractable tape has a metal or plastic body with a 13mm or 19mm wide blade connected to a return spring inside the body, which retracts the blade. The blade is usually a white or yellow colour with black markings at 1mm, 10mm, 100mm and metre intervals. They range in length from 1.0m to 8.0m Long site setting out tapes are available in metal or plastic bodies with a winding handle attached to the side. The older style blades were made from cloth but the most commonly used materials are metal and fibreglass. They come in lengths of 10.0m up to 100.0m and may be used for setting out building sites, measuring up for fences, etc.

Fig. 2 Typical tapes

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Pinch Rods

These consist of two pieces of small sectioned timber, any spare dressed batten material may be used, with square or tapered ends pushed between two surfaces and overlapped in the centre. While holding firmly in this position place a mark across the edges of the two pieces. The rods are laid on a bench, the top piece lined up with the mark on the bottom piece and then the overall length is measured with a tape or rule. These rods are very useful when an accurate measurement is required to be taken between surfaces and the use of a tape or rule is very awkward or the measurement is difficult to see in a confined space, eg. inside a linen press or cupboard when measuring the length of a shelf.

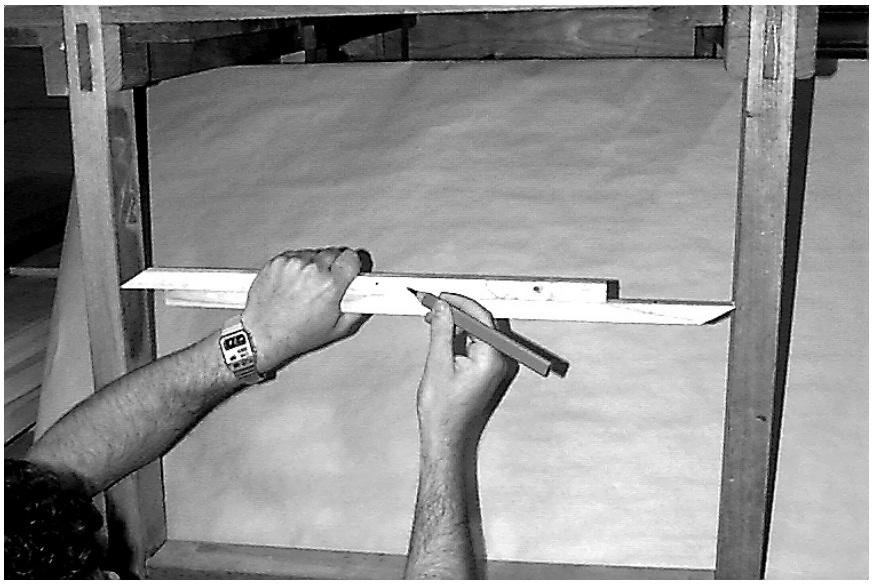

Fig. 3 Using pinch rods

SQUARES AND BEVELS

Try square

This tool is used for testing or "trying" the face and edges of timber for square or used when marking the face or edge of timber at 90°. It may have a timber or metal stock connected to a metal blade set at exactly 90° to the stock. The stock is pressed firmly against the edge or face of the timber while a pencil or marking knife is run along the edge of the blade.

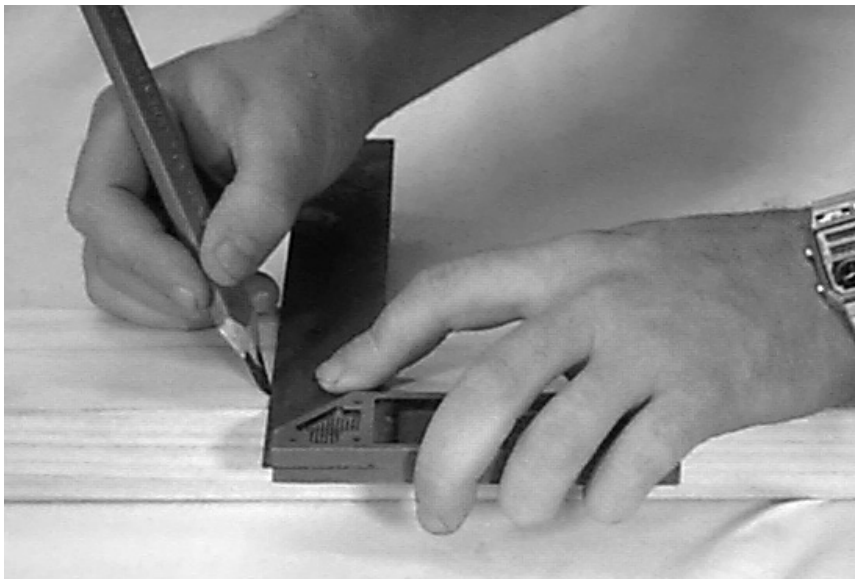

Fig. 4 Try square

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Combination square

This square is made of metal with an adjustable blade, which is able to slide in the stock. It is used to mark 90° lines, but it may also be used to mark 45° angles, due to the shape of the top of the stock. There is also a fixed-type 45° mitre square available, but the combination square is the most useful tool to have due to its many functions. It may also be used as a gauge with a pencil to mark parallel lines to the edge or face of timber.

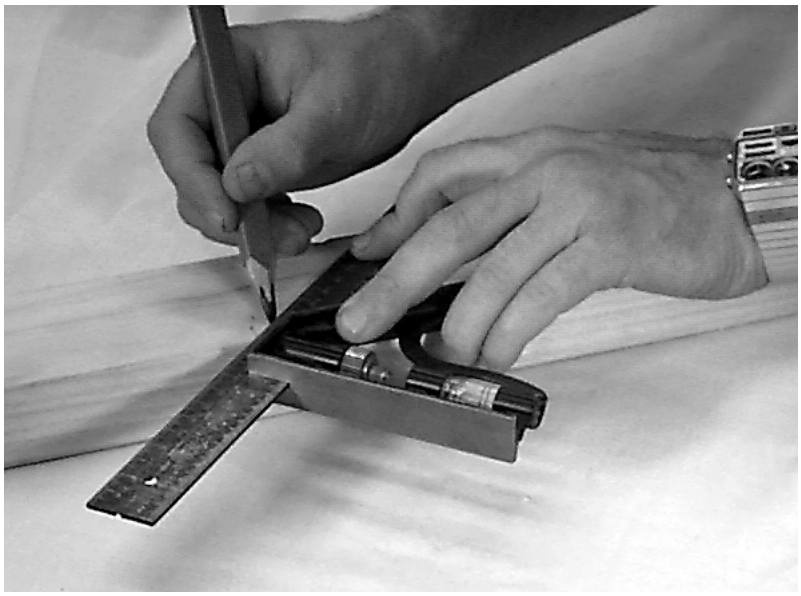

Fig. 5 Combination square

Carpenter's Steel square

The steel square, or roofing square, is a fixed steel blade tool set at 90°. The main blade is 600mm long x 50mm wide and the tongue is 400mm long x 40mm wide. The blade and tongue have metric graduations every 2mm and there are a variety of finishes available to allow for easy reading.
These squares may be used for setting out roof rafter lengths and forming bevels when used in conjunction with an adjustable timber fence or steel "buttons". When the square is reversed it may be used to set out for stairs by sliding the fence or buttons along the edge of the stair string and marking the position of the treads and risers along the outside edge, which form a 90° angle.

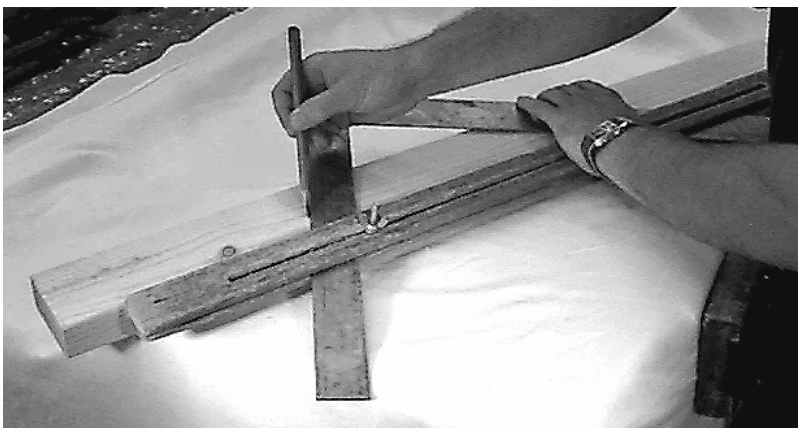

Fig. 6 Steel square

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Sliding bevel

This is an adjustable bladed tool used to mark or transfer angles other than the fixed angles of 90° and 45°. It may have a timber or metal stock and a metal blade which is tightened with a fitted wing nut.

Fig. 7 Sliding bevel

MARKING TOOLS

Marking and Mortise gauges

These tools are made from timber having a stock which slides along the stem. It has one or more sharp scoring spurs. The stock is fixed in position using a coarse threaded thumb screw. They may be used for scoring lines parallel to the face or edge of timber to allow accurate cutting, planing or chiseling. The mortise gauge is used more specifically for setting out pairs of parallel lines for mortise and tenon joints. It has one fixed spur and one which is adjusted to suit the width of the mortise or tenon.

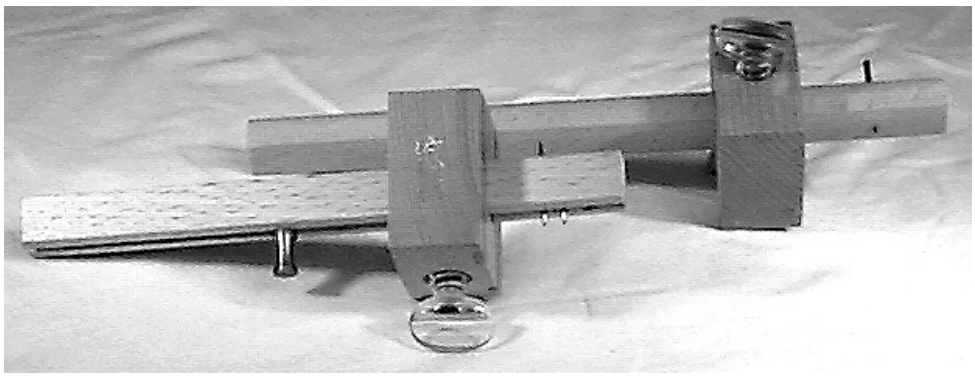

Fig. 8 Marking and Mortise gauges

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Cutting gauge

This tool is very similar in appearance to the marking or mortise gauge, but instead of having a pointed spur it has a removable cutting blade, which is held in position by a steel or brass wedge. The gauge is mainly used to score parallel lines across the grain by sliding it along the end of the timber. It may also be used for ripping thin timber, veneers, formica, etc. instead of using a saw.

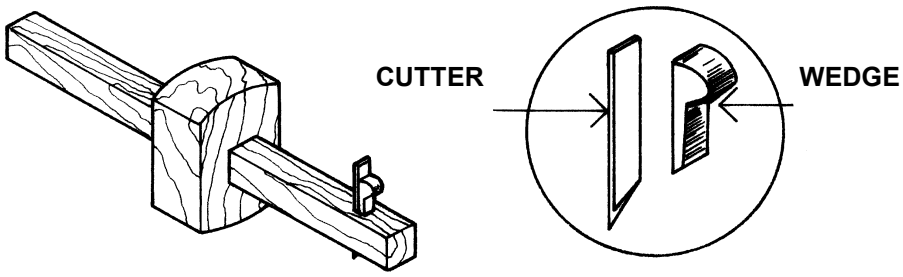

Fig. 9 Cutting gauge

Carpenter's Pencil

This pencil differs in design from the normal drawing pencil in that it has a larger lead and is rectangular in section. This larger size allows for robust use on-site when working on materials with a coarse texture like rough sawn timber, concrete, brick, etc. The lead is available in soft, medium and hard grades to allow a clear line to be seen, even on wet surfaces.

Fig. 10 Carpenter's pencil

Marking Knife and Scriber

This tool is approx. 200mm long with an angled cutting edge at one end, with the other end tapering to a point. The sharpened cutting edge is mainly used for cutting across the grain of joinery timbers so that the fibres are parted at the surface. This allows a saw or chisel to be worked exactly to the mark and avoids tearing of the fibres during these operations. The pointed end is mainly used to pinpoint measurements and marking centres.

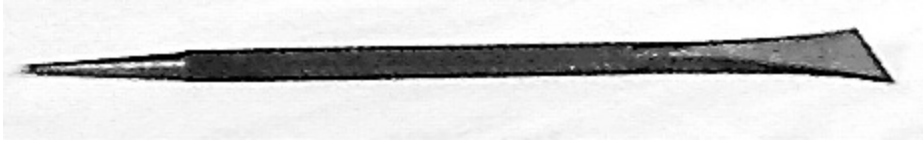

Fig. 11 Marking knife and Scriber

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Trammel

A trammel consists of a variable stem or beam, usually a small sectioned dressed batten, and two adjustable fittings. This allows one end to act like the point of a compass and the other to act like the marking point of a compass. It is a very useful tool for setting out large curves, arcs and circles for a variety of tasks. The radius of the curve, arc or circle is only limited by the length of the stem.

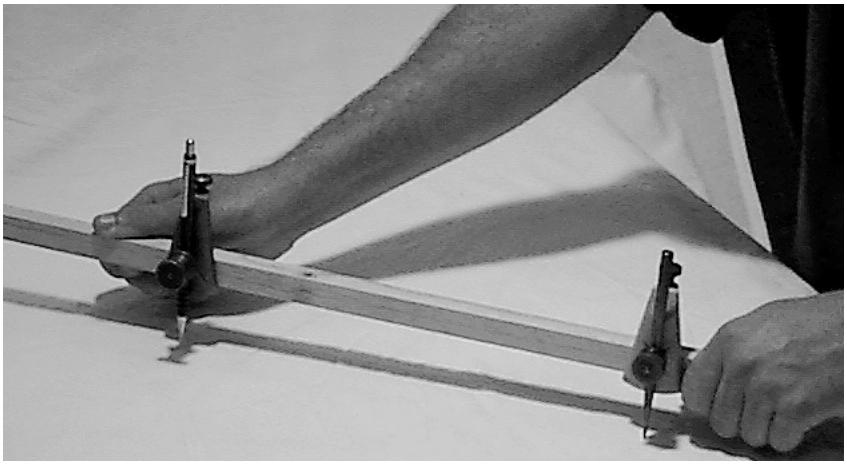

Fig. 12 Trammel

Chalk line

Also known as a 'flick' line, due to the method of use, it consists of a metal or plastic casing (partly filled with a fine coloured chalk powder) and string line on a spool connected to a small handle. The chalk is left on the surface when the line is flicked. It may be used to set out temporary straight lines on the surface of concrete, masonry, formwork, steel, etc. There are a variety of chalk colours available such as red, blue, yellow, purple and white, which may be easily washed off the surface.

Fig. 13 Chalk line and chalk refill bottle.

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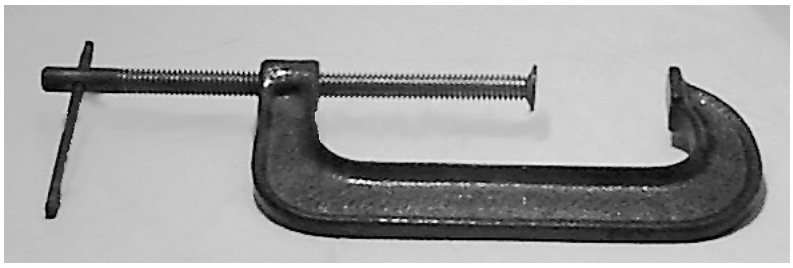
HOLDING TOOLS

'G' Clamp

This clamp, as the name implies, is a holding device formed from steel in the shape of a 'G'. It has a coarse threaded screw handle and comes in a variety of jaw opening and throat depth sizes to suit the type of work being held.



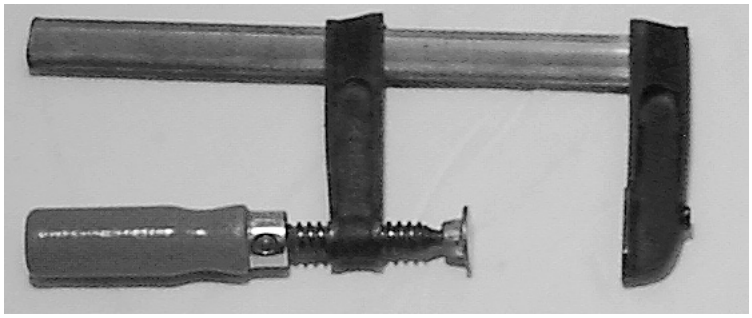
Capacity	
Jaw opening	**Throat depth**
50	25
75	50
100	50
300	100

Fig. 14 'G' Clamp

Used to clamp two items together or to secure material to the workbench during construction.
A deep throated version is also available where increased throat depth is required.

Quick Action Bar clamp

This clamp has one fixed jaw, with the other being capable of sliding the full length of the steel bar. It may be locked off or screw adjusted using the attached coarse threaded handle. Very useful for holding a variety of jobs and materials.



Capacity	
Jaw opening	**Throat depth**
100	60
up to	
2000	120

The advantage of this clamp is that it may be quickly and easily opened to a variety of positions and removed just as easily.

Fig. 15 Quick action clamp

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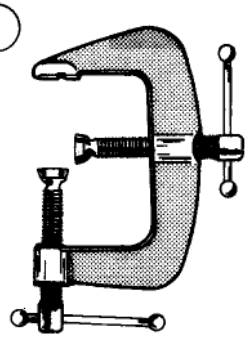
Special Purpose clamps

There are a variety of clamps made for specific jobs apart from the 'G' clamp and quick action clamps. These include edging clamps, mitre corner clamps, fretwork clamps, floor clamps and spring clamps.

1



EDGING CLAMP

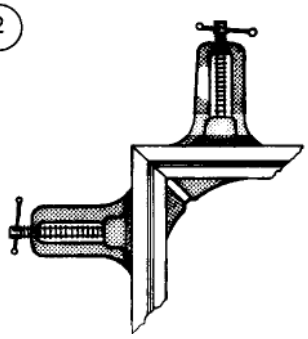
CAPACITY

JAW OPENING	THROAT DEPTH
60	32

A miniature clamp which is used to hold edging strips and lippings to straight or curved work.

Eg. Bench tops and tables.

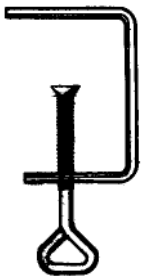
2



MITRE CORNER CLAMP

Various types are available all of which are primarily intended to hold framework at the corners. They are very useful for securing mitre joints during construction.

3



FRETWORK CLAMP

CAPACITY

JAW OPENING	THROAT DEPTH
50	25

A miniature clamp for holding thin material or small work such as in fretworking.

4

HOLDFAST BENCH CLAMP

CAPACITY

MAX. OPENING	MAX. REACH
175	149
194	179

Very useful for firmly holding work flat on the bench. They can be used to hold jobs not easily held in a vice. They can hold long lengths or wide material either on or over the edge of the bench. They are fitted into a collar which is recessed into the bench top.

Fig. 16 Variety of special purpose clamps

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Sash cramps

These cramps are available with a round or 'T' bar for the adjustable locking clamp to slide on. The locking clamp may be secured by friction jaws onto the pipe or by a steel pin placed into pre-drilled holes spaced at approx. 100mm centres. There is a screwing device fitted to the fixed jaw at one end, which allows for final pressure application to the job. They are used for cramping wide jobs where greater pressure than the smaller clamps is required.

They are available in bar lengths of 610mm up to 2135mm and have a working capacity (Max. adjustment) of 460mm up to 1980mm.

Fig. 17 Sash cramp

Vices

Bench or table vices used by Carpenters and Joiners are usually of a cast iron body with a sliding jaw. The inside face of the jaws is protected with a thin piece of timber to prevent bruising to dressed timber. Some types have a quick action device fitted, which allows fast opening and closing of the vice prior to the final tension being applied by the adjustable coarse threaded screw handle.

Other vices available are the more solid Engineers vice, drill press vices, small table vices, pipe vices, chuck type pin vices and bench stops.

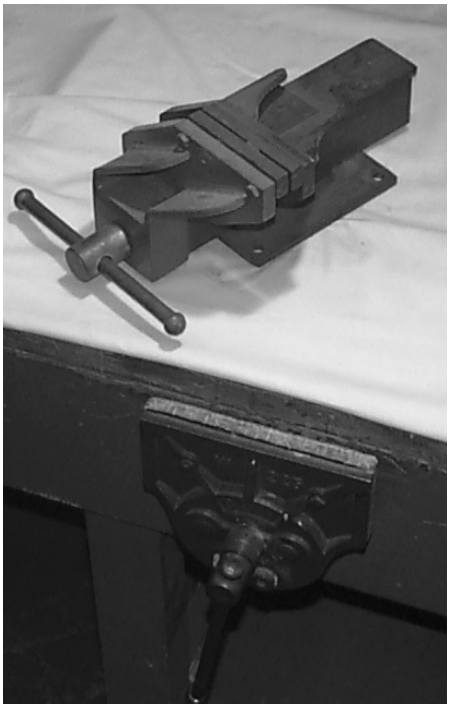

Fig. 18 Joinery bench vice and Engineers vice

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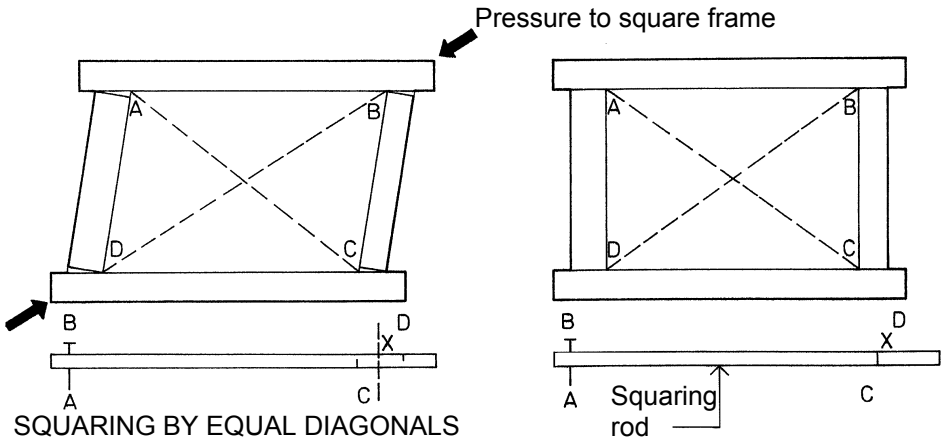
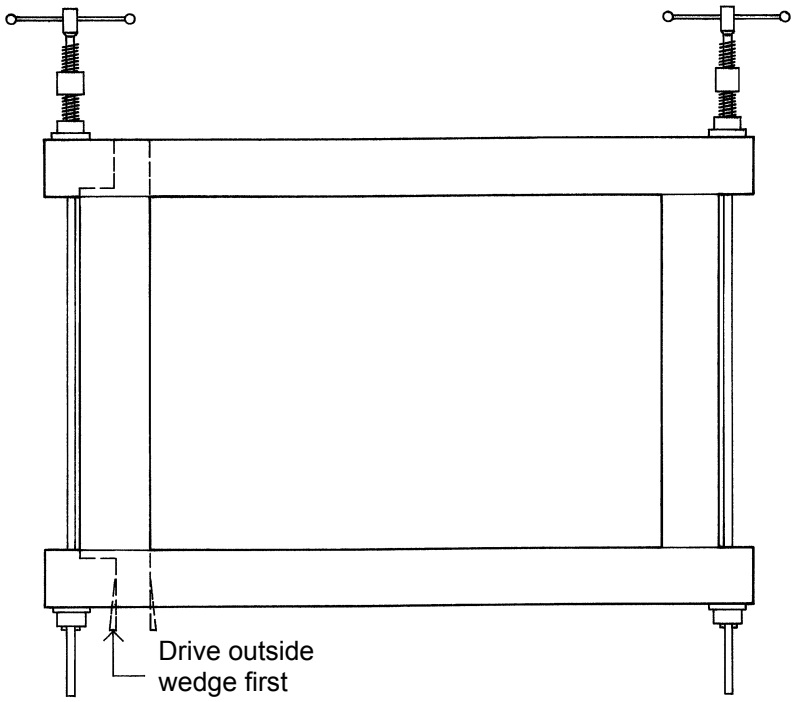
Squaring and Cramping

The following steps outline the method when you square and cramp a small frame.

SETP 1 Using the squaring rod, measure the lengths of the diagonals AC and BD
STEP 2 Bisect CD on the rod to obtain the position of equal diagonal length, 'X'.
STEP 3 Adjust the frame until the diagonals are equal on point 'X'.



SQUARING BY EQUAL DIAGONALS



CRAMPING THE FRAME

Fig. 19 Squaring and cramping a small frame

CUTTING TOOLS

Saws

Saws are classified as *abrading* tools because their cutting action scrapes or wears away the material being sawn. Each type of saw is designed for a particular use, such as:

- Straight cuts with the grain, across, and at an angle to the grain;
- Cutting around shapes and forming curves; and
- Cutting metal, plastic, plasterboard and fibre cement.

Parts of a saw

The basic features and terms common to all saws are:

- The blade;
- The handle; and
- The teeth

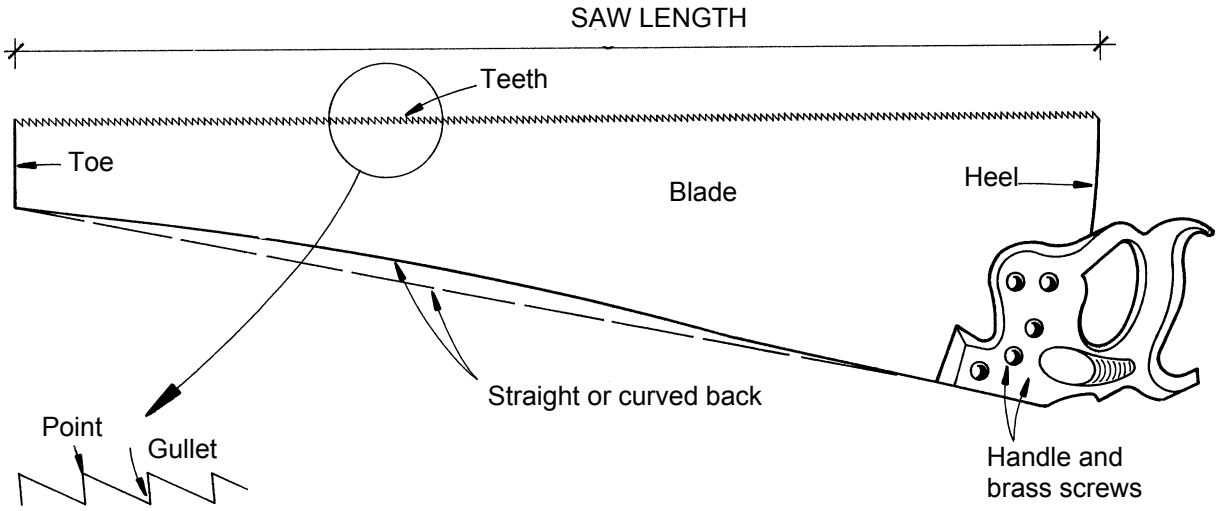
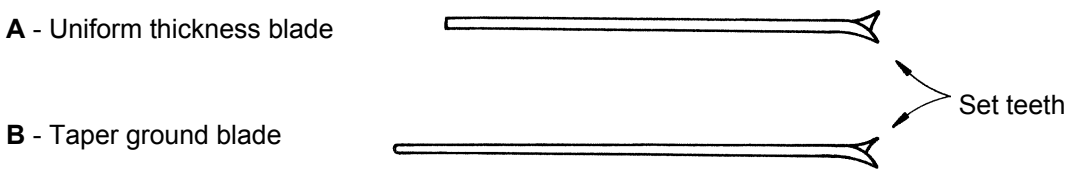


Fig. 20 Main parts of a saw

The Blade

The blade is a flexible piece of high quality steel into which teeth have been shaped. Good quality blades are taper-ground towards the back, which helps to prevent the blade jamming in the kerf. The length of the blade generally indicates the size of the saw, eg. a 600mm bladed saw is called a 600mm saw.



These section through saw blade types shows the effect that 'set' has in providing working clearance for the blade.

Fig. 21 The blade

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The Handle

Saw handles are made from timber or moulded plastic and are shaped to provide a comfortable grip. The handle is usually connected to the blade by three or more brass screws, depending on the size of the saw.

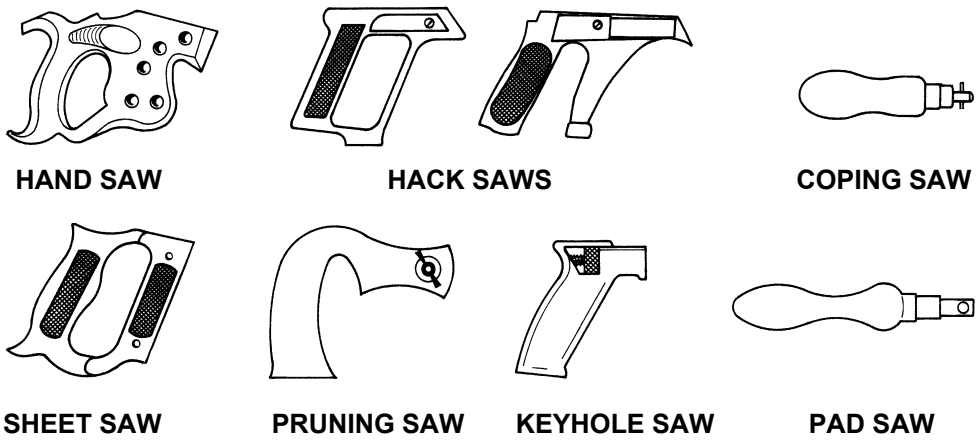

Fig. 22 Saw handles

The Teeth

The number and shape of the teeth vary according to the type of saw. The important features are:

- The Tooth Pitch — This refers to the angle or 'hook'on each tooth. The angle is measured from the line of the top of the teeth to the front edge of each tooth. The angle may vary from 80° to 90° for rip saws and 70° to 75° for crosscut saws.
- The Points — These are the tops or points of the teeth. They are counted by the number of points per 25mm length of blade. They are counted at the gullet position, therefore there may be 8 points but only 7 teeth per 25mm length.

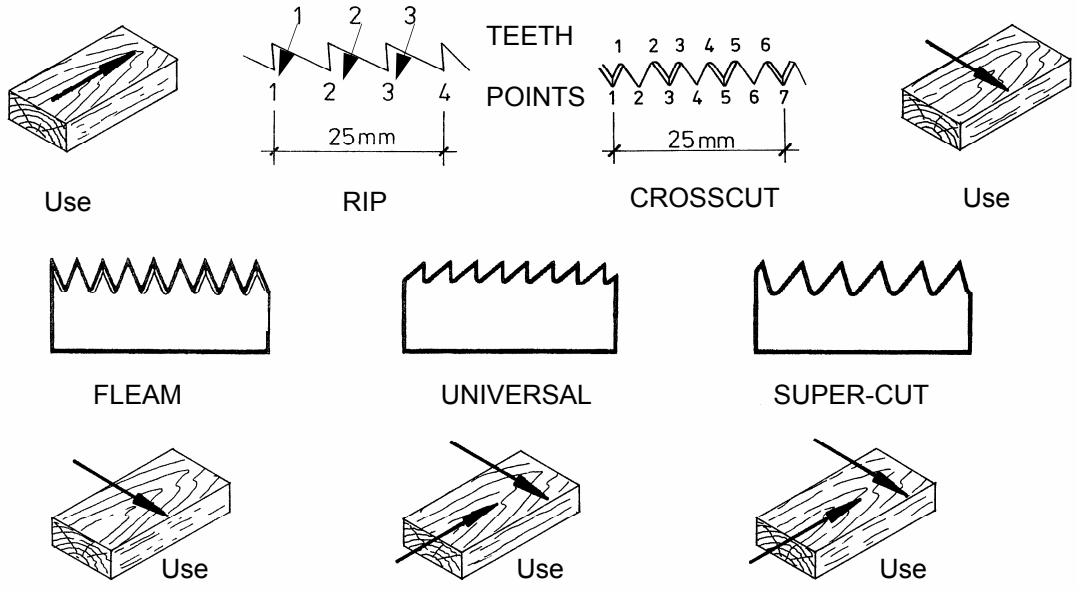

Fig. 23 Types of teeth and Points per 25mm

Rip saws

These are usually large hand saws used for straight cutting with only a few square-topped teeth per 25mm of blade, to allow for easier ripping along the grain. The teeth are designed to cut like 'chisels' creating a fairly coarse kerf *along the grain*. The saw is held at approx. 60° to the timber, for most efficient action, and the forefinger is extended on the outside of the handle towards the end of the blade, for best control. Thinner timber may be ripped using a 'half-rip'.

Halfgrip saws range in blade length from 600mm to 700mm and have 3 to 6 points per 25mm of blade length. The handles may be of timber or hollow plastic and the saws are available in a wide variety of brands. The portable power saw has superseded this hand saw and therefore it is rarely seen on the job site.

Fig 24 Using a Rip Saw

Cross cut saws

This range of saws is used for straight cutting with many pointed teeth per 25mm of blade to allow for clean, non-tearing cutting across the grain. The teeth are designed to cut like a 'knife' by slicing the fibres to create a fine cut *across the grain*. These saws are available for a range of uses, from fine detailed joinery to heavy site construction work. Common saw types available are;

Cross cut Hand saw

These saws are available with blade lengths from 550mm to 700mm and have 5 to 9 points per 25mm. They are used for general cutting of framing and large section size timber, with the saw being held at approx. 45° for most efficient action. The forefinger is extended on the outside of the handle, towards the end of the blade, for best control.

Fig 25 Using a Hand saw

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Cross cut Panel saw

These saws are available with blade lengths from 450mm to 500mm and have 10 to 12 points per 25mm. They are used for cutting thin timber, timber sheet material such as ply and hardboard, and cutting fixing out timbers such as skirtings and architraves. The saw is held at approx. 30°, for most efficient action, which also prevents the saw jamming in sheet materials. The forefinger is extended on the outside of the handle, towards the end of the blade, for best control.

Fig. 26 Using a Panel saw

Back saw or Tenon saw

Although essentially a crosscut saw, these saws may be used to rip or crosscut small sectioned timber for the production of joints, eg cutting tenons, and timber mouldings for fixing out such as quads, cornice, planted stops, etc. The steel blade is also fitted with a rigid steel or brass *back* to prevent the thin blade from twisting or warping in the kerf. The saw is usually held very flat for most efficient action. The forefinger is extended on the outside of the handle, towards the end of the blade for best control. They vary from 350mm to 550mm in length with 11 to 14 points per 25mm.

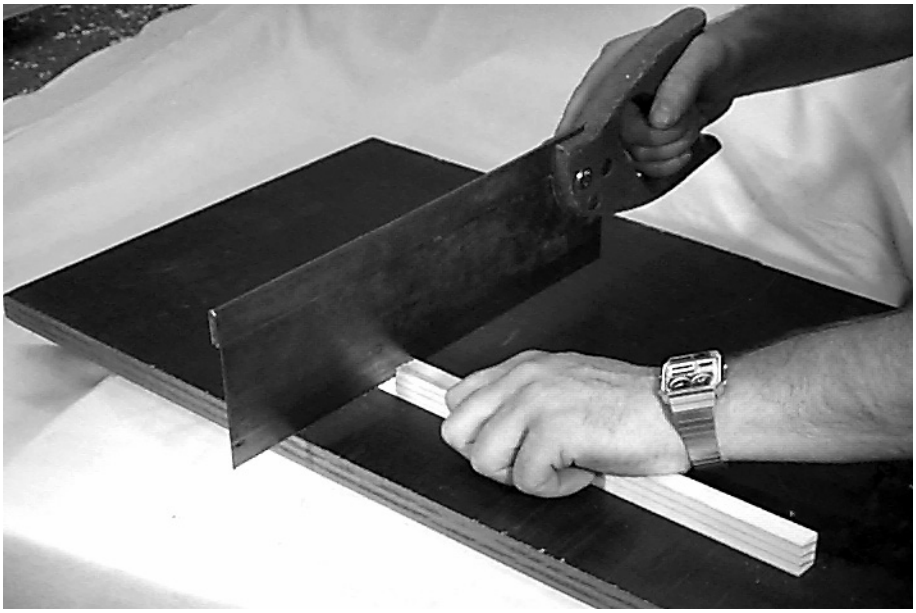

Fig. 27 Using a Tenon saw

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Dovetail and Bead saws

These fine toothed saws are used for cutting dovetail pins, shoulders for joints on narrow rails, beads, mouldings and other fine straight cutting work. The saws have relatively short blades, of around 200mm long, and fine crosscut teeth at 15 to 17 points per 25mm.

Fig. 28 Dovetail and Bead saws

Combination saw

This is an all-purpose saw with specially shaped teeth, called *fleam* teeth, which cut cleanly and efficiently on the forward and back stroke, both across and with the grain. They are available in several sizes of hand, panel and tenon saw types.

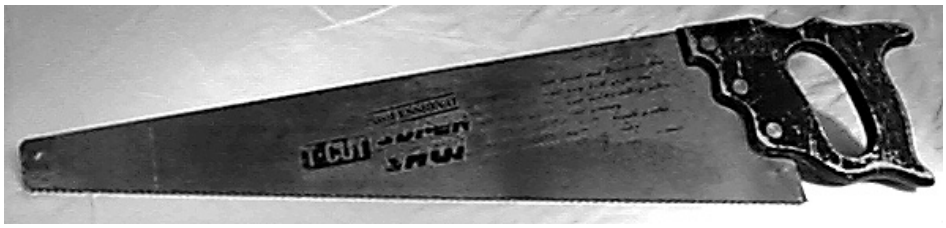

Fig. 29 Combination saw

Veneer saws

These saws are flat ground, sharpened and set, generally have a plastic coated blade, and a plastic handle. They are approx. 320mm long with *universal* teeth at 13 to 14 per 25mm. The end of the blade is curved with teeth, to allow the starting of a kerf in the middle of the surface. Fine toothing gives fine cut faces on timber and porous materials.

Fig. 30 Veneer saw

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CUTTING, DRIVING AND EXTRACTING TOOLS

CHISELS

Chisels come in a variety of shapes, sizes and materials designed for use by bricklayers, stonemasons, cabinet makers, carpenters and joiners.
Chisels for use on masonry are generally solid steel forged tools driven with a mallet or lump hammer, requiring a great deal of force in most cases. They are known as masonry chisels.

Chisels for use on timber may be described as being hand-guided, edged tools consisting of a steel blade, ground to a bevel at one end to form a cutting edge, and a hard plastic or timber handle. These chisels may be used for paring, shaping, mortising or just removing waste timber to create a joint. There are two basic types of timber chisels named according to the method of securing the handle, ie. the socket type and the tang type.

Masonry Chisels

Cold chisel

These chisels are available in a variety of sizes ranging from 10mm to 25mm x 200mm long, in the 'flat' grouping, and up to 38mm x 375mm long, in the 'long flat' grouping. These chisels are mainly used by bricklayers and stonemasons for scabbling masonry materials, including concrete.

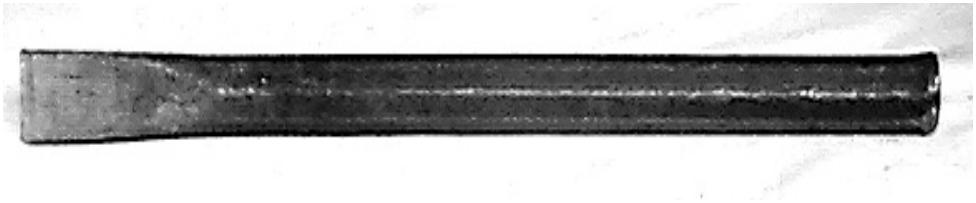

Fig. 33 Cold chisel

Plugging chisel

This is a long steel one piece chisel, approx. 250mm, with a small diameter handle at one end and a flat broad blade, approx. 20 x 6mm, tapering to a blunt point at the other. It is mainly used by bricklayers for chopping out mortar from *bed* and *perp* joints, when removing a brick from a wall with out damaging the surrounding work.

Fig. 34 Plugging chisel

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Mason's chisel

A one piece steel chisel usually 25mm x 300mm long used for light dressing of stone. There are a variety of special purpose chisels available for use by the stonemason.

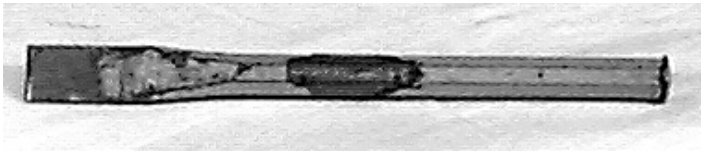

Fig. 35 Mason's chisel

Mason's point

These chisels are a long, slender one piece steel tool available in lengths of 250mm to 610mm used to chop stone and to remove chunks of concrete waste material. The smaller sized tools may be used for more delicate stone dressing and finishing.

Fig. 36 Mason's point

Scutch chisel

This chisel is used mainly by bricklayers and stonemasons to scabble the face of brickwork and masonry to either cut to a rough shape or remove waste. It consists of a one piece steel handle and a slotted friction jaw, which holds a replaceable toothed '*scutch comb'*.

Fig. 37 Scutch chisel

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CHISELS USED FOR TIMBER

There are two basic methods used to secure the cutting blade to the handle. These are the 'socket' and the 'tang' methods. The most common method used is the tang, with a moulded hard plastic handle. It is designed to be used with a timber mallet but is strong enough to withstand the force of a steel claw hammer, when hit with the side of the hammer head.

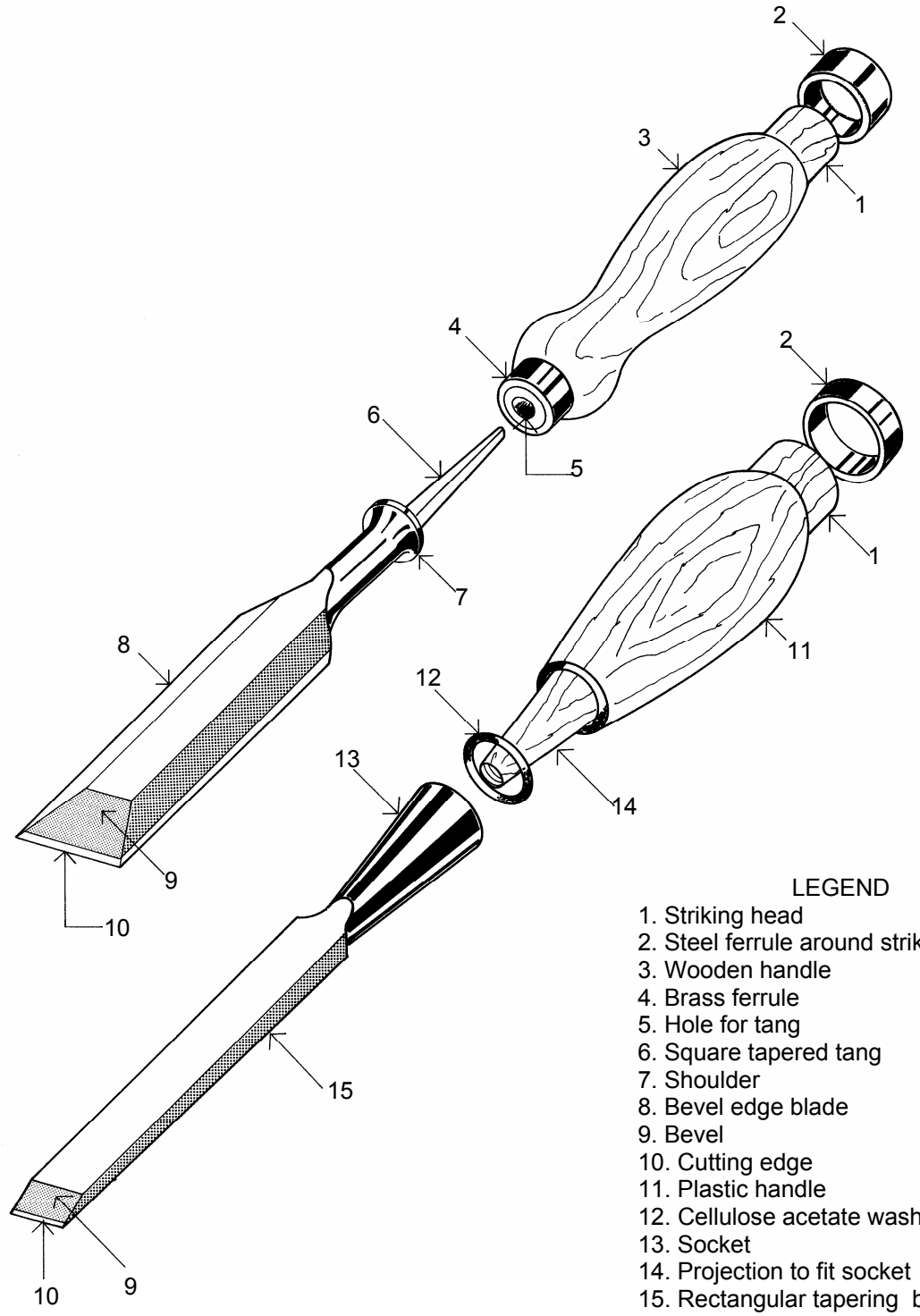

Fig. 38 Socket and Tang type chisels

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USE OF CHISELS

Paring chisel

This chisel has an extra long thin blade with either square or bevelled edges. It is used for light work, such as finishing off joints, and is driven by hand pressure only. The bevelled edge allows for ease of movement in a tight check out, but is not as strong as the square edge types. They range in size from 10mm to 32mm and are ideal for cleaning up the surface of a trench or recess in joinery timber work.

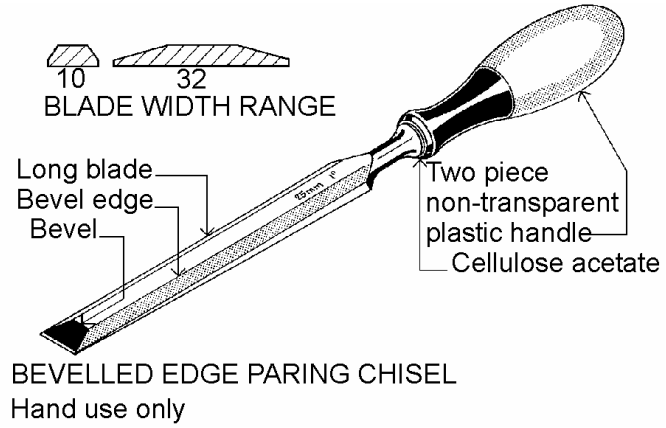

Fig. 39 Bevelled edge paring chisel

Firmer chisel

Although similar in appearance, these are stronger than bevelled edge paring chisels and may have either square or bevelled edges. They are designed to be driven with a timber mallet for general joinery use and are available in bevelled edge blade sizes of 6mm to 50mm and square edge blade sizes of 12mm to 32mm.

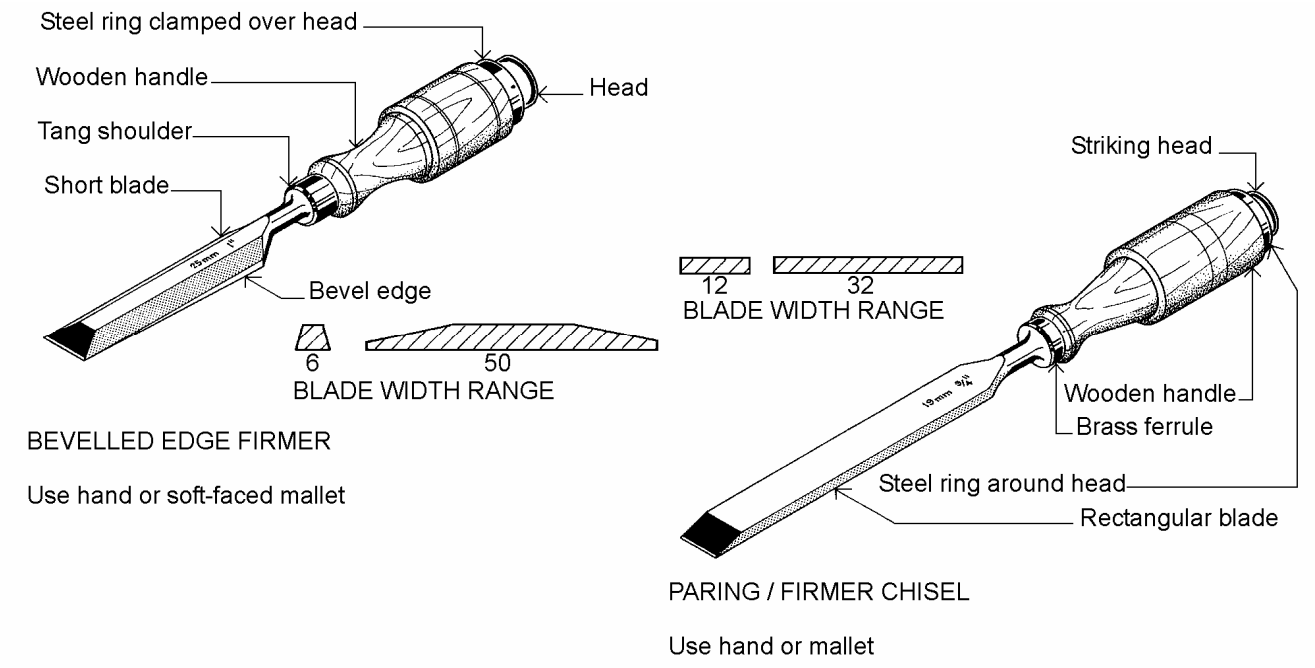

Fig. 40 Firmer chisel types

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Registered Chisel

This is a heavier type of firmer chisel with the blade being about twice as thick as the lighter types. Timber handled chisels are fitted with a steel ferrule at both ends of the handle and a leather washer fitted between the shoulder and handle to absorb the shock. Hard plastic handles are also commonly used for thse chisels allowing them to be driven with some force without splitting thye handle, provided the side of the hammer head is used.

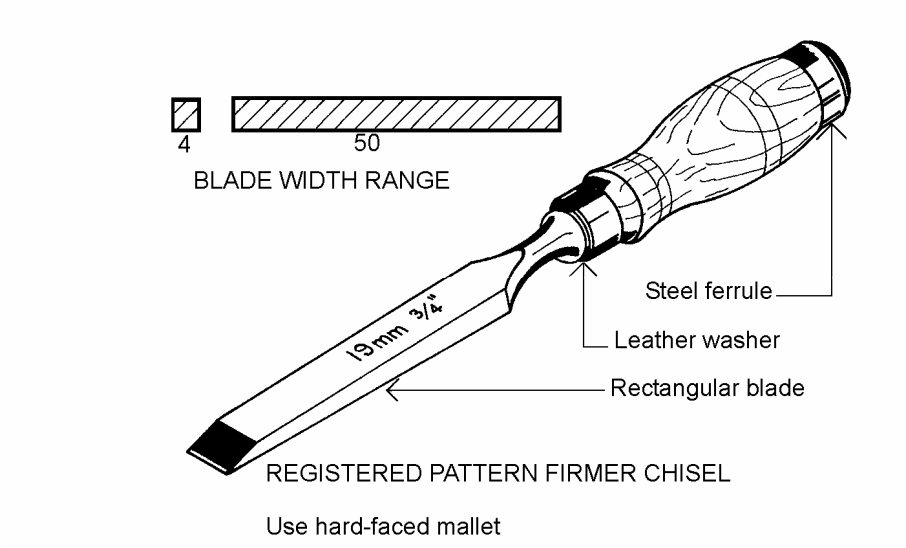

Fig. 41 Registered type chisel

Mortise chisel

This is used for extra heavy work or very firm driving, such as the creation of a mortise for joinery work. The blade is thicker and stronger than other chisels, taking the blows of a timber mallet with ease, and be used to lever out tight waste from a mortise. The handle may be fitted with a ferrule at the top and a socket at the bottom, for timber handles, and are also available with moulded plastic handles.

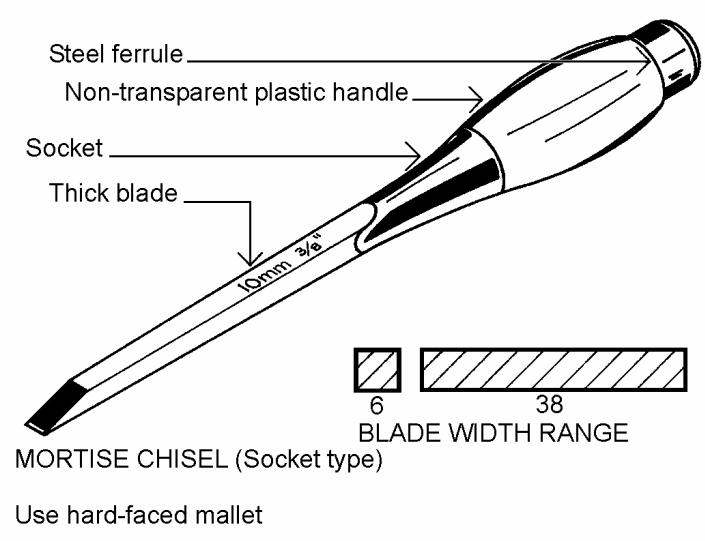

Fig. 42 Mortise chisel - socket type

Butt chisel

This chisel is much shorter than the average firmer chisel, but is manufactured in the same way. It is mainly used for letting-in hinges and similar work, where a longer chisel would be harder to control.

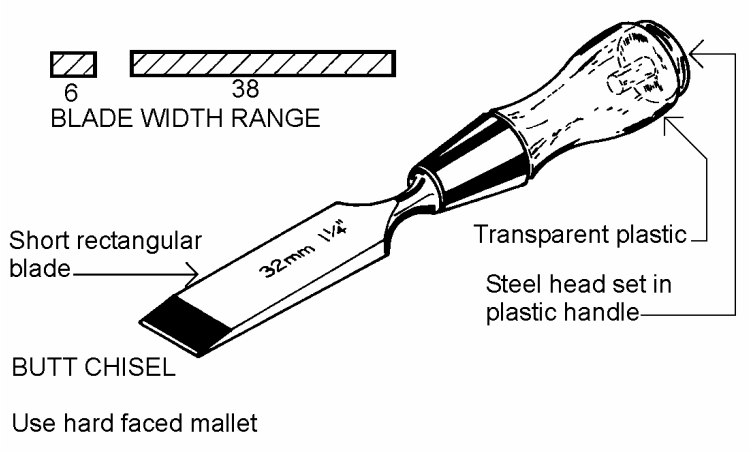

Fig 43 Butt Chisel

Gouges

The gouge is a special shaped chisel, with its blade curved in cross-section.

The firmer gouge is sharpened on the convex face and is used for grooving, fluting and general carving. The sizes range from 3mm up to 40mm blade width.

The scribing or paring gouge is sharpened on the concave face and is used for removing waste from curved work. The sizes range from 3mm up to 40mm blade width.

The size of a gouge is measured straight across the blade and there are a variety of sweeps or curves available ranging from ‘flat’ to ‘quick’.

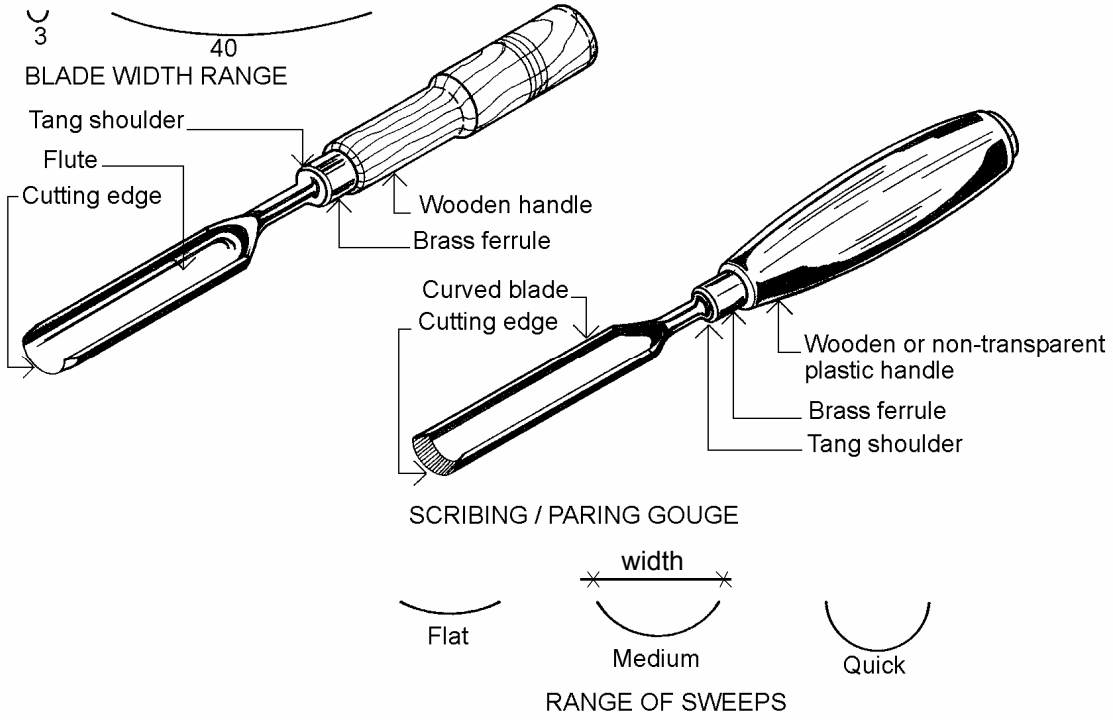

Fig. 44 Gouges

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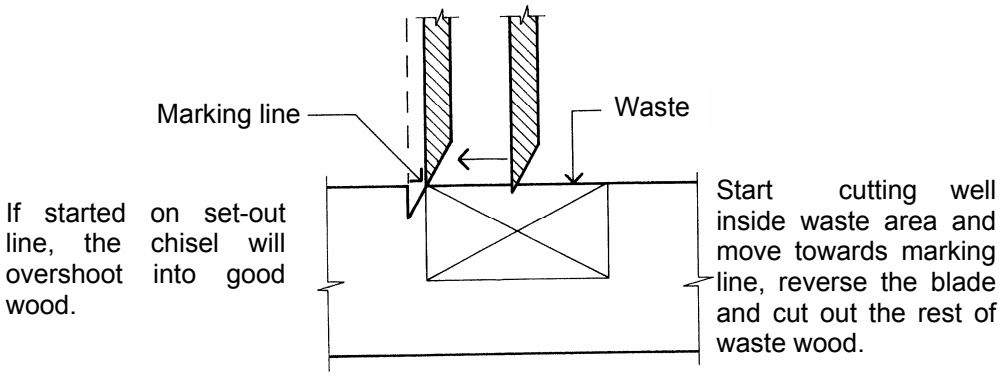
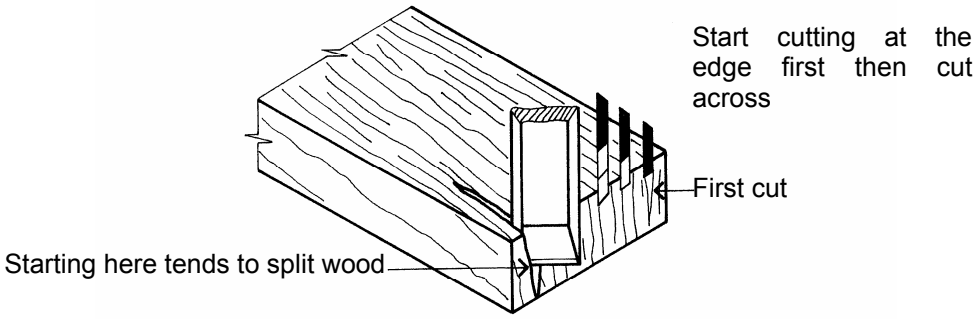
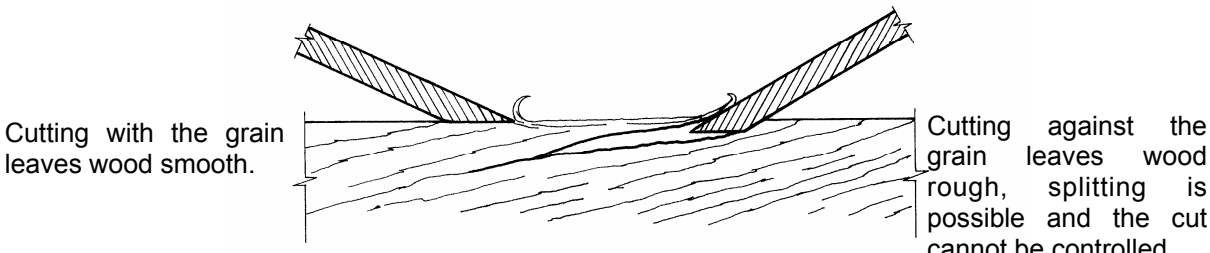
CHISELLING TECHNIQUES



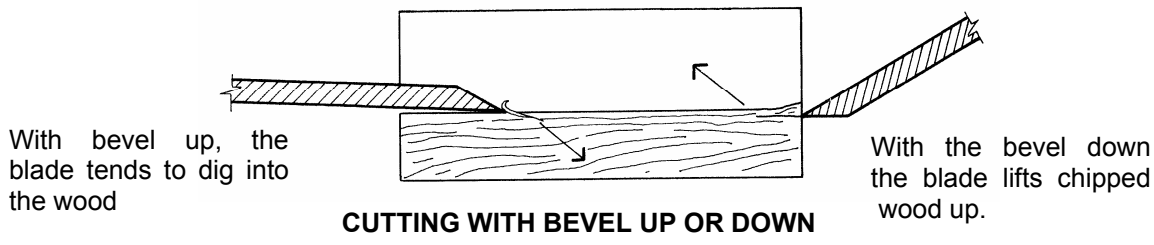
CORRECT WAY OF STARTING THE CUT



VERTICAL PARING ON CORNERS AND ENDS



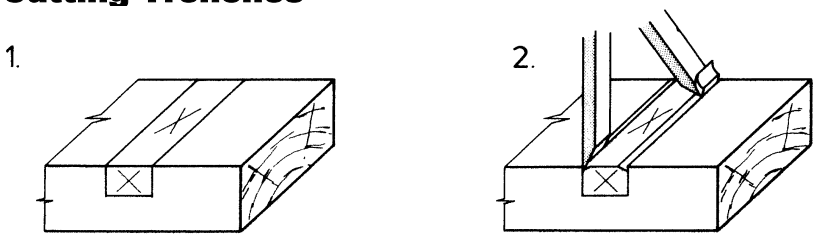
CUTTING WITH OR AGAINST THE GRAIN



CUTTING WITH BEVEL UP OR DOWN

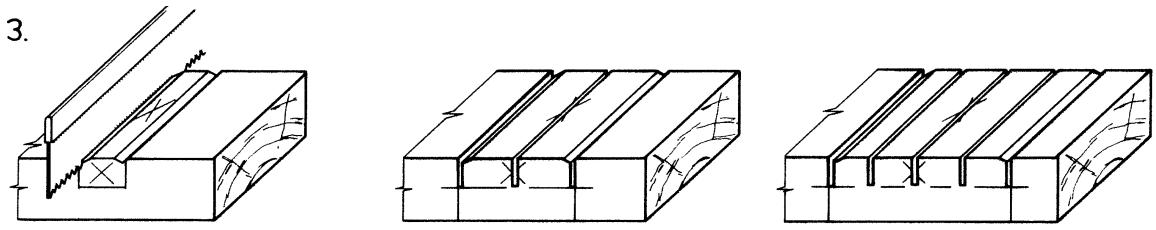
Fig. 45 Correct and incorrect chiselling techniques

Preparing and Cutting Trenches



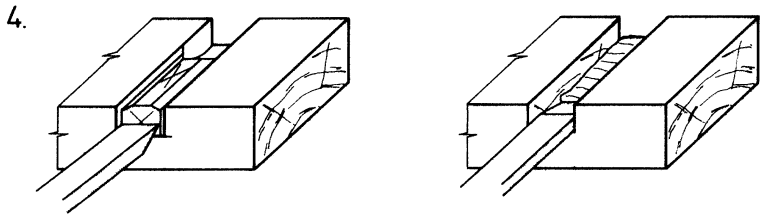
Mark position of one side with marking knife, set out width using other member as guide, square down edges and gauge depth.

Cut grooves along the side lines with chisel as shown then chisel trench on waste side of line.



Saw on waste side down to gauge line depth.

If the housing is wider, make extra saw-cuts to facilitate chiselling, finish these cuts slightly above line depth. Finish the joint as shown below.

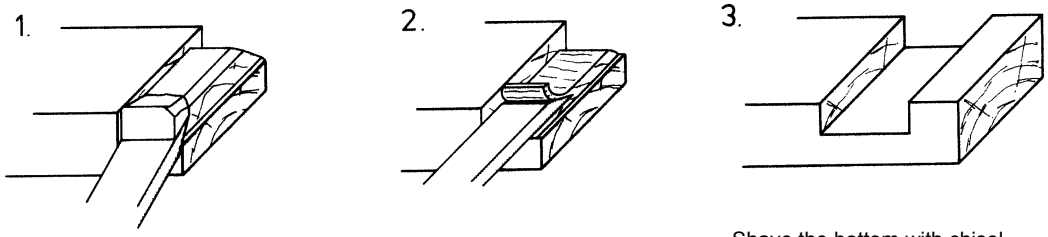


Remove waste with chisel bevel down from both sides.

Pare from both sides with chisel bevel up.

Fig 46 Method of Chiselling a trench

Preparing and Cutting Housings and Halvings

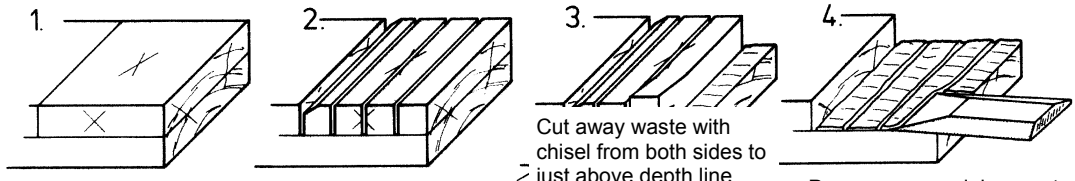


Chisel out waste a little at a time from both sides cutting upward. Keep the chisel bevel down

Pare away the centre waste until the bottom is reached. Keep the chisel bevel up

Shave the bottom with chisel, moving from side to side until the depth line is reached check flatness with a try square.

CUTTING A HOUSING JOINT



Mark out width of waste on top and sides and depth on sides and end.

Chisel-cut sawing trench, then saw-cut on waste side, cut extra grooves to facilitate chiselling.

Cut away waste with chisel from both sides to just above depth line. Keep the chisel bevel down.

Pare away remaining waste with chisel cutting from end, then shave the bottom until smooth. Check flatness with a rule. Keep the chisel bevel up and make slicing motions.

CUTTING A HALVED JOINT

Fig. 47 Methods used to chisel joints

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DRIVING AND EXTRACTING TOOLS

Screwdrivers

These tools are used to turn screws into place and also remove them. The most common types are made from chrome vanadium steel with a hard translucent, extruded cellulose-acetate handle. Some of these handles are also fitted with a hole through them to allow the fitting of a ‘tommy bar’ to allow for extra purchase.

Apart from the standard fixed type with a square 'Phillips' or 'Posidrive' head, there are special purpose screwdrivers such as the ratchet type, spiral ratchet and offset screwdrivers. The later being used for tight spots or extra leverage when screws are hard to drive or withdraw.

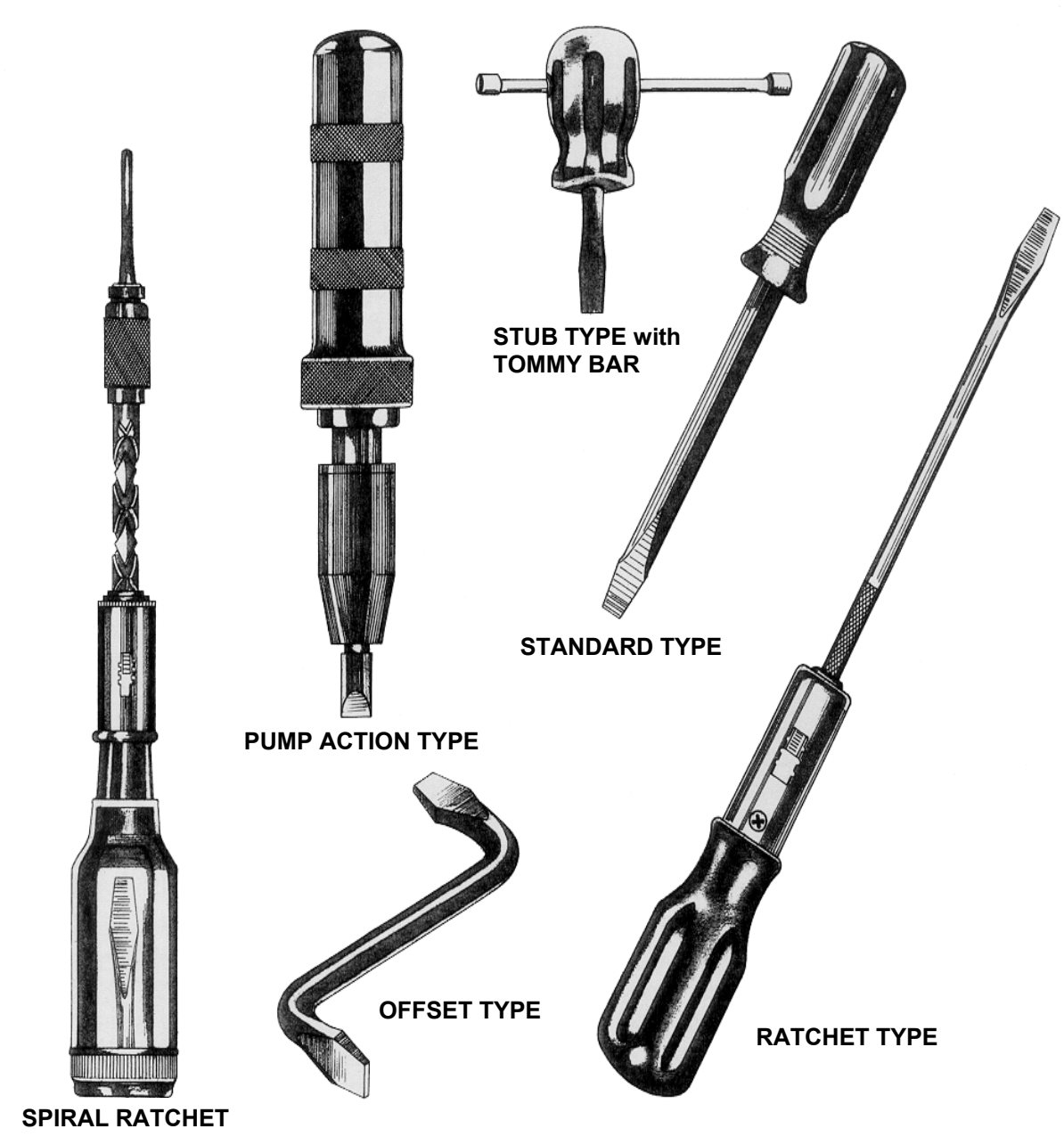

Fig. 48 Variety of Screwdrivers

HAMMERS AND MALLETS

Timber Mallet

This tool may be described as being a wooden-headed hammer made especially for striking chisels and knocking frames together. It consists of a hardwood timber head, brush box being suitable, and a handle, spotted gum or hickory is recommended, which is usually wedge-fitted into the head to prevent it working loose. To ensure the striking faces on the head are in-line with the object being hit they are tapered towards a point, representing the position of the elbow, which is the axis of rotation when the mallet is in use.

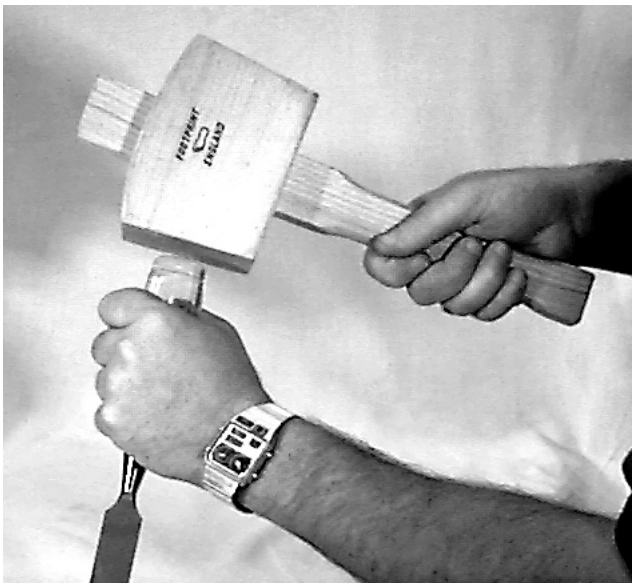

Fig. 49 The Timber Mallet in use

Claw hammer

This is the most useful hammer for a carpenter to use for general purposes. These hammers come in a variety of styles and materials ranging from a separate metal head with a timber handle, (usually hickory) to a fully polished one piece head, shaft and handle type with a leather or rubber grip. Other types include tubular steel and fibreglass shaft hammers with a rubber grip. These hammers are designed for all facets of carpentry and joinery work and cater for strengths in persons who use them. The face may be 'mill-faced' for plasterboard work or 'smooth-faced' for general purpose use. The smooth-faced hammers have the face slightly *crowned* to allow for the correct axis of rotation which ensures the face always strikes the nail at 90°.
The following table gives an indication of the various hammer head weights available;

TABLE 1
Hammer head weights

Metric weight	other common Imperial weight
230gm	8oz
340gm	12oz
450gm	16oz
570gm	20oz
680gm	24oz
794gm	28oz

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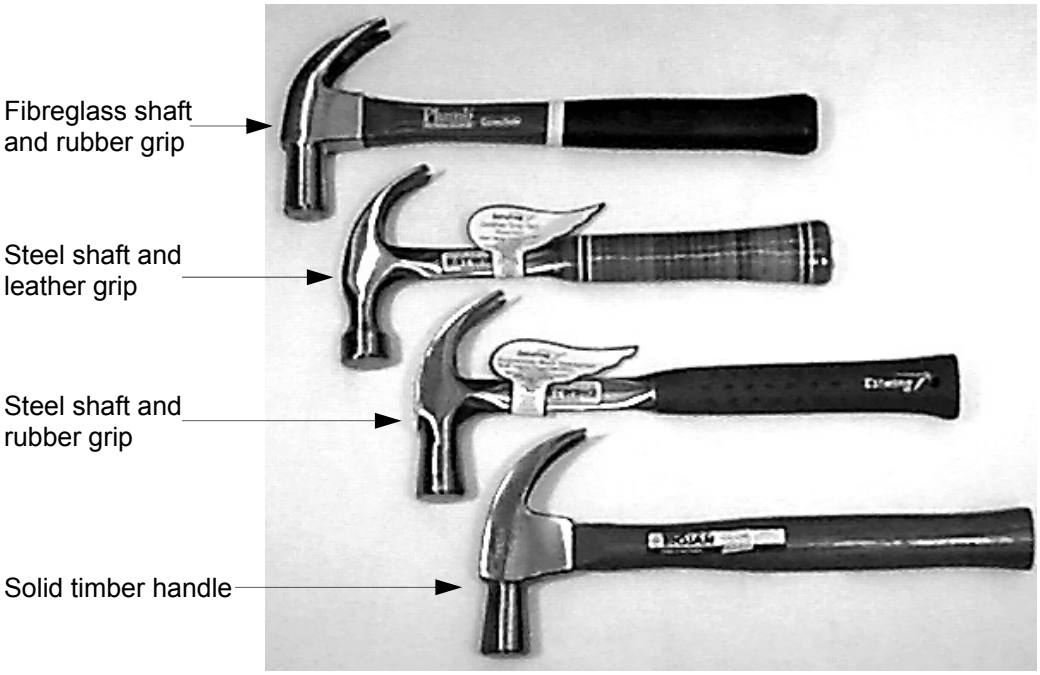

Fig. 50 Common types of claw hammers

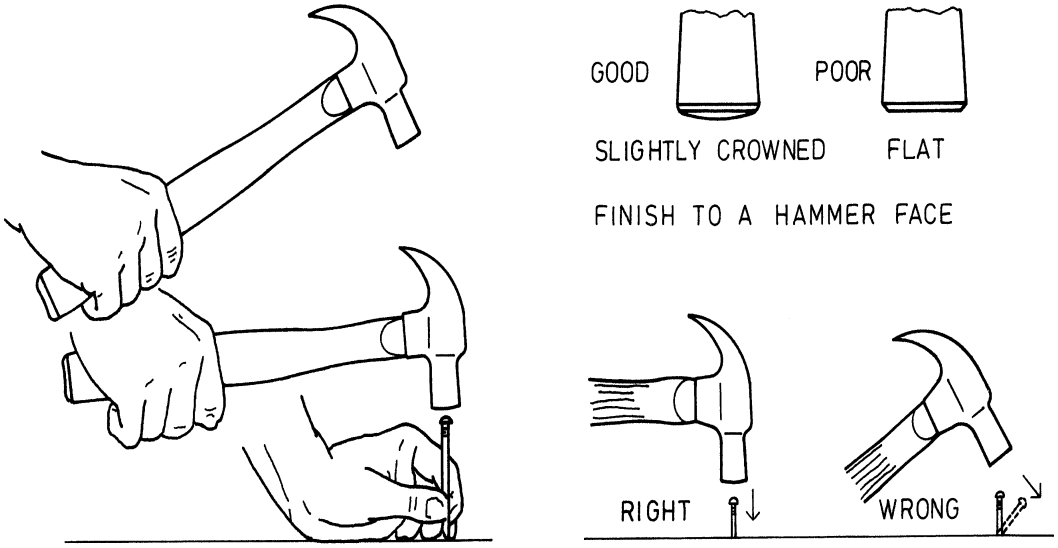

Fig. 51 Correct use of a claw hammer

Brick and Scutch hammers

These are specialist hammers used mainly by bricklayers. They are available in similar styles and materials as the claw hammers.

The brick hammer has a chisel-like end, for striking bricks to snap them off at a set length, to trim the rough edges off cut bricks, and the other end has a square or round face for nailing clouts to timber frames or driving bricklayer's line pins into joints.

The scutch hammer has a head with either one or both sides having a slotted friction-fit jaw which holds a *scutch comb*. The scutch comb is a double sided toothed cutter, which is easily replaced when worn out. This tool is used to scabble the face of bricks and masonry to form a rough shape or remove waste.

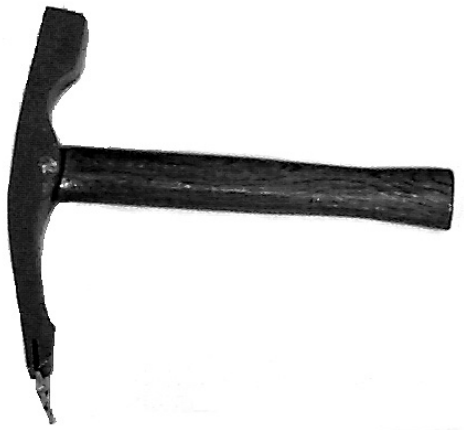

Fig. 52 Scutch hammer

Club or Lump hammer

These hammers basically consist of a solid steel head, of varying weights, with a timber, usually hickory, or steel handle. They are used mainly by bricklayers and stonemasons to drive cutting tools such as scutch chisels, bolsters, points, cold chisels, plugging chisels, mason's chisels, etc. The available weights are given below:

TABLE 2
Club or Lump hammer weights

Metric weight	other common Imperial weight
0.910kg	2lb
1.140kg	2½lb
1.360kg	3lb
1.810kg	4lb

Fig. 53 Club or lump hammer

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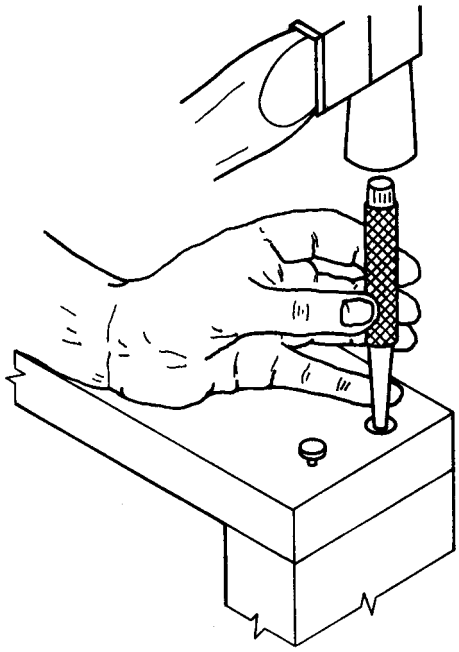
Nail punch

The nail punch is a small steel tool used to drive or 'punch' nail heads below the surface to allow for a dressed appearance, when the holes are filled with putty or a coloured filler, and sanded. Punching the head below the surface, especially in polished timber flooring or decking, prevents the nail head from protruding above the surface when the timber shrinks.

Nails should be punched approx. 2mm below the surface for joinery work and at least 3mm below for flooring work. The nail punch is also useful when hammering in tight situations.



For invisible nailing on a finished surface it is advisable to drive the nails below the work surface. Leave about 3mm of nail projecting above the surface and carefully sink it with a nail punch. To prevent the punch from slipping off the head of the nail, rest the little finger on the work and press the punch firmly against it. Set nails about 2mm below the surface, fill the holes with plastic wood of the matching colour and sand level when dry.

DANGEROUS
Burrs on the top of a nail punch.

Fig. 54 Using a nail punch

EXTRACTING TOOLS

Pincers

These tools are very similar to pliers but are mainly used for extracting small nails. To avoid damaging joinery timber or timbers, which are to be re-used, place a piece of thin scrap timber or thick cardboard under the jaws of the pincers to prevent bruising of the timber and to aid leverage. This is also the best method to use when extracting with a claw hammer or pinch bar and the added leverage prevents timber hammer handles from being snapped off, during extracting operations.

Fig. 55 Pincers

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Wrecking or Pinch bar

This is usually a one piece steel bar with a flat chisel-like end for levering at one end and a claw for extracting nails and screws at the other. These tools are very useful during demolition and dismantling of formwork. It's use for extracting nails is similar to that of the claw hammer and a piece of scrap timber under the claw will assist with leverage and prevent damage to timber surfaces. The bars are available in sizes ranging from 300mm to 1200mm long.

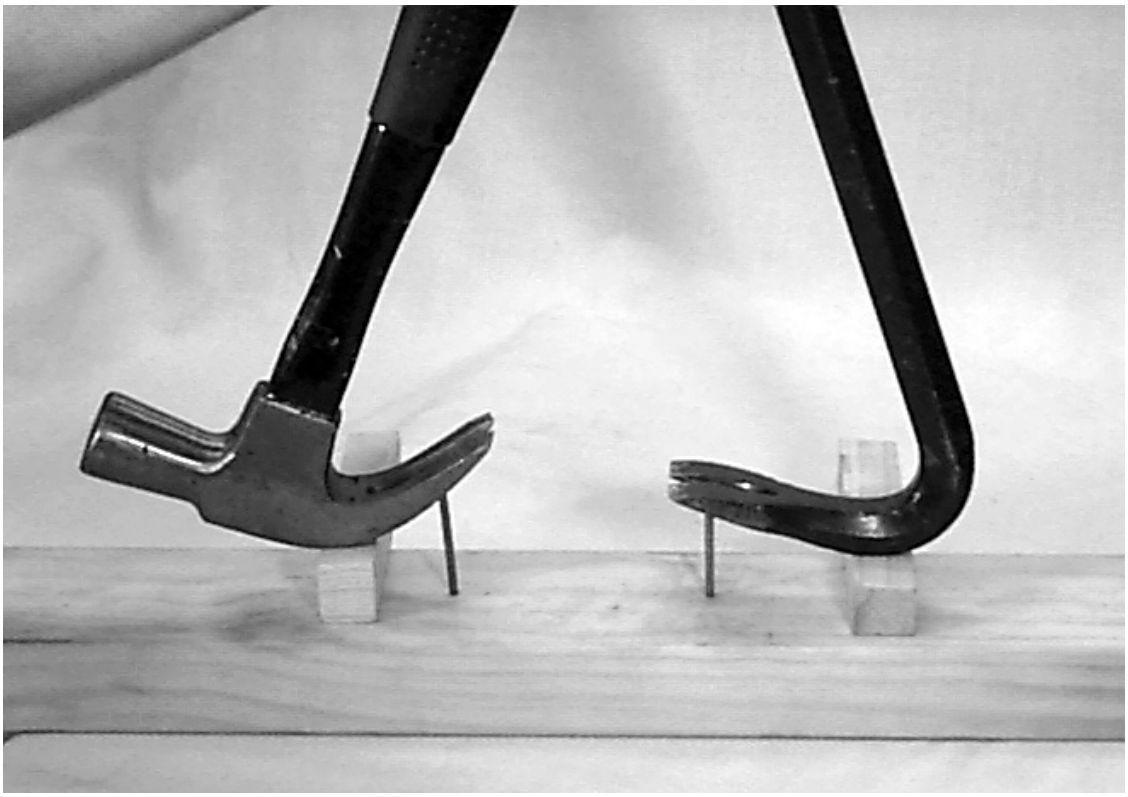

Fig. 56 Using a wrecking bar and claw hammer to extract nails.

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DRESSING TOOLS

Planes

As the name implies, planes are cutting and dressing tools used to form plane, flat or moulded surfaces. There are many types of hand planes available, with a great variety of uses. There are three groups of planes which have been classified as 'bench planes', owing to their frequent use for bench operations. These are, taken in order of use, the jack planes, the trying planes and the smoothing planes. There are several adjustable and removable parts to a plane which are outlined as follows:

Knob

Is screwed to the stock near the toe of the plane and is usually made of rosewood timber or plastic. This piece of the plane is used to control the plane and apply even pressure during use.

Lever cap

This is a thick metal plate-like piece fitted with a lever at the top. It is used to apply a holding pressure on the two irons ensuring they stay fixed in place during use.

Back iron

This is a thin metal piece screwed to the cutting iron. It has a rounded end which is placed above the cutting iron edge to curl the shavings away from the surface of the timber, thus preventing the fibres from splitting and tearing in front of the cutting iron. The back iron also serves as a stiffener to the cutting iron to prevent the cutting iron from *chattering* or jumping on the timber surface during use.

Cutting iron

This is made of mild steel with a tool steel face welded to it's front surface. This tool steel face is ground and sharpened to form the cutting edge. Tool steel is essential for the blade as mild steel is too soft and will allow the edge to be lost very quickly or the cutting edge to become gapped easily.

Depth adjusting nut

This gives a greater or lesser amount of cutting iron edge projection through the mouth which will produce a coarse or fine cut. This nut should be used to retract the blade below the surface of the body when the plane is not being used or is in storage, to prevent the cutting edge from being damaged.

Frog

This is like a mounting piece to support the two irons and the lever cap. It can be adjusted to give greater or lesser mouth opening and may be removed, if desired, to service and clean the plane.

Handle

This is at the rear of the plane and held tightly in one hand so a thrusting pressure may be applied to the plane to move it forward. It may be of rosewood timber or plastic.

Stock

This is the body of the plane which is made of cast iron, with the sole and upturned sides machined perfectly flat. With excessive use the sole of the plane may become scored or even concave in shape and will require machining on a *linisher*.

Lateral adjusting lever

This is used to produce an even amount of cutting iron, which projects through the mouth of the plane parallel to the sole.

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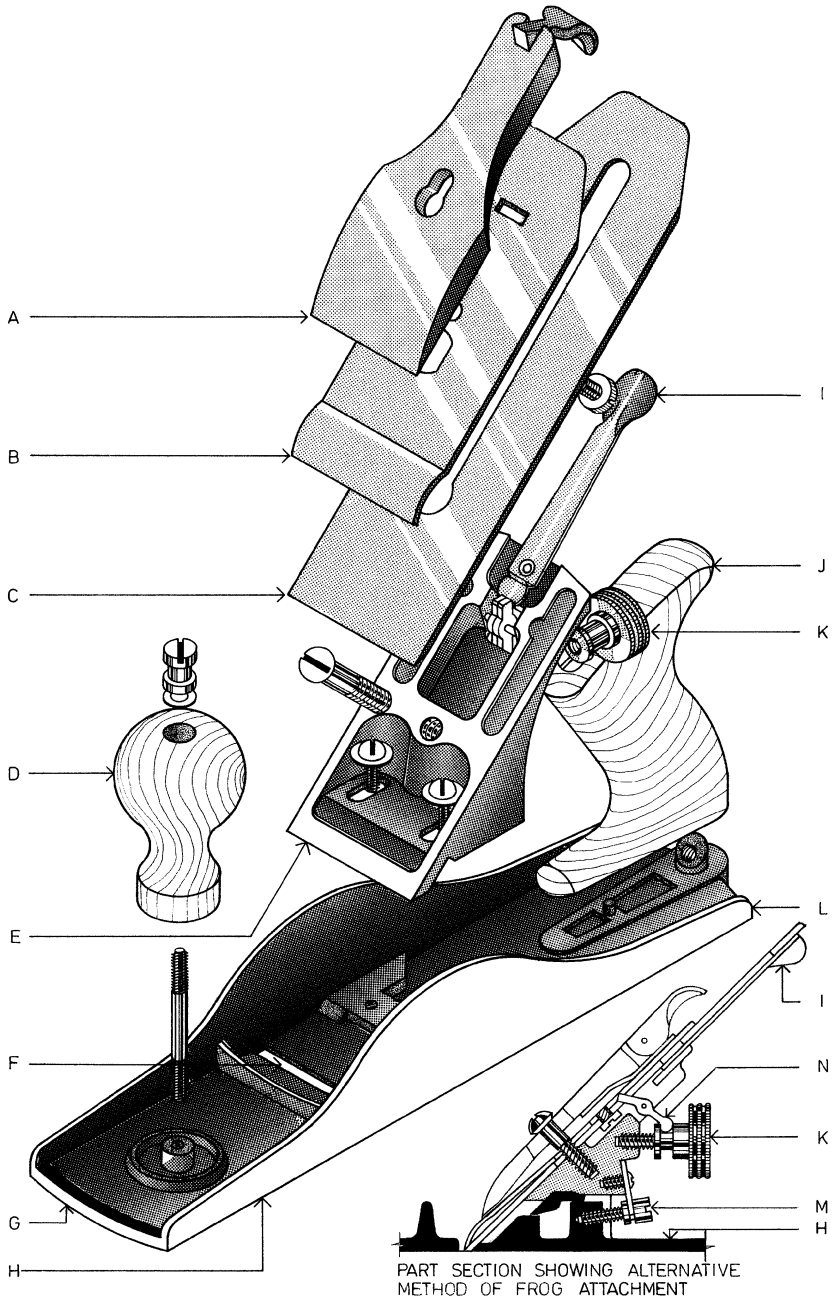

Fig. 57 Parts of a plane

Legend for plane parts

A	Lever cap	**H**	Stock or body
B	Back iron	**I**	Lateral adjusting lever
C	Cutting iron	**J**	Handle
D	Knob	**K**	Depth adjusting nut
E	Frog	**L**	Heel
F	Throat	**M**	Frog adjusting screw
G	Toe	**N**	'Y' adjusting lever

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THE COMMON BENCH PLANES

German jack

This plane is used to reduce rough sawn timber to its approx. shape and size. The plane has a timber body, a heavy cutting iron and a timber wedge to hold it in place. There is no back iron to curl the shavings, therefore it tends to tear rough shavings off quickly. The cutting edge has a convex curve allowing it to bight deeply into the timber surface. This plane is rarely used today as a portable power plane will do the job more quickly and efficiently, therefore it is only used as a back up tool where power is unavailable.

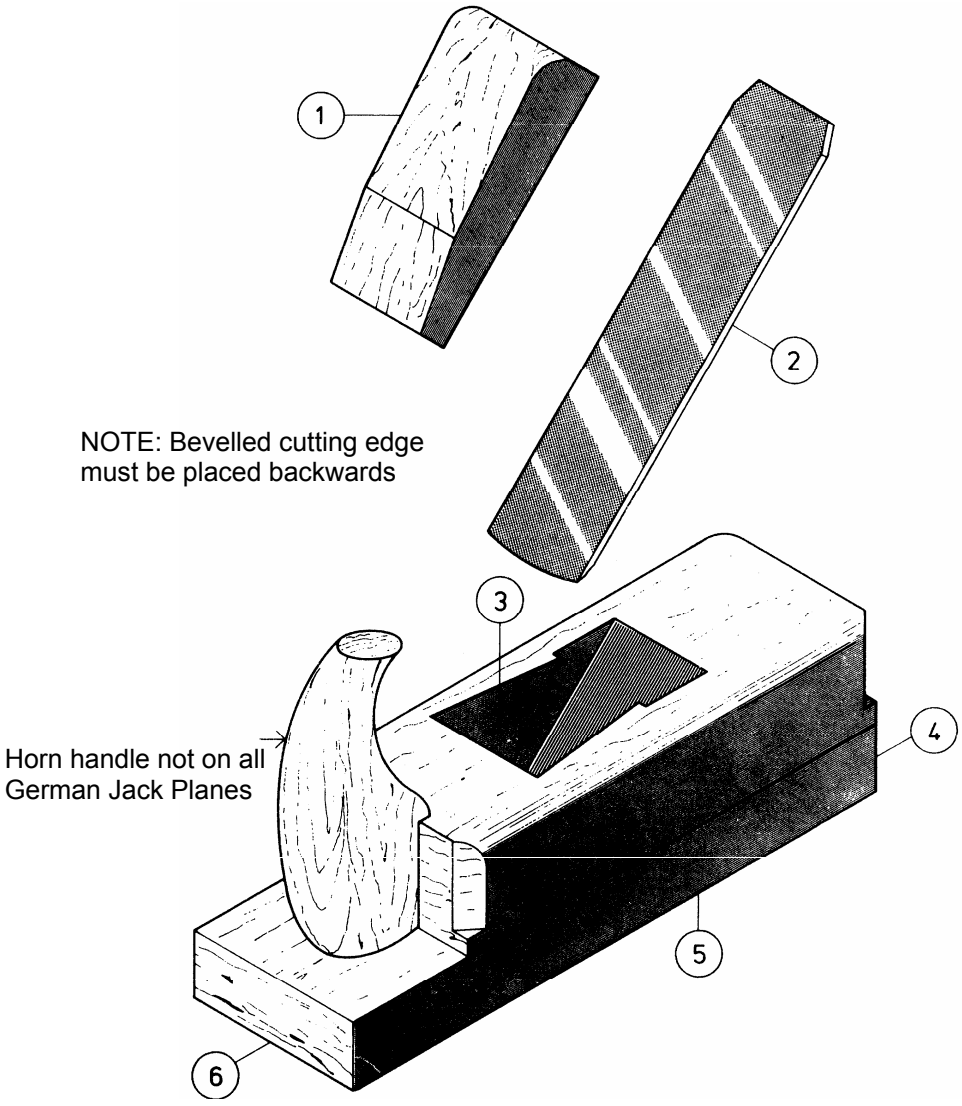

Fig. 58 German jack plane - timber stock

Legend for plane parts

1	Wedge
2	Cutting iron or Plane iron
3	Throat
4	Heel
5	Face
6	Toe

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Jack plane

The Jack plane, or No. 5 as it is commonly called, is used in the early stages of timber dressing to remove unwanted timber with a minimum of time and effort to form a surface which is approx. true and to size. Under close inspection of the surface a series of wide grooved cuts would be formed.
The stock is made of machined metal and is available in lengths of 350mm, No. 5, to 375mm, No.5½, and is fitted with a cutting iron 50mm to 60mm wide. Generally the blade is ground with a slight convex curve to allow for a quicker cutting action. It is fitted with a cap iron and a back iron to curl the shavings.

Fig. 59 Jack plane

Trying plane or Jointer

This plane is used after the jack plane to form a surface which is accurate, straight and true. It has a cutting iron, which is straight within it's length, with the corners slightly rounded to prevent the blade tearing the shavings and prevent marks being left. The other common use of this plane is for shooting long edges on timber joinery and is very useful for planing the edges of doors.
The stock is made of machined metal and is available in lengths of 450mm, No.6, to 550mm, No.7. It is fitted with a cutting iron 60mm wide, a cap iron and a back iron to curl the shavings.

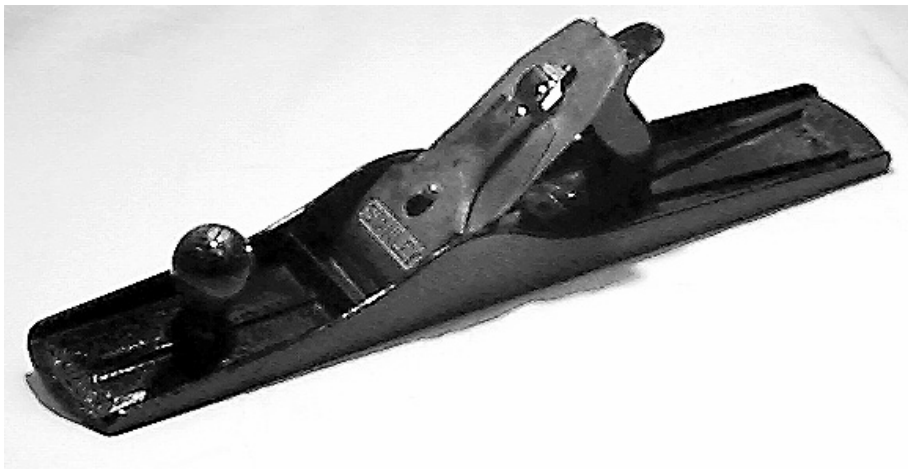

Fig. 60 Trying plane or Jointer

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Smoothing plane

This is the last plane used prior to sanding of the job and is designed to remove fine shavings and other plane marks. This stage is called 'cleaning off'. The blade is ground perfectly straight with only the very tips of the corners rounded to prevent marking of the timber. It may also be used for *shooting the end grain* as it is a smaller, stockier plane, which is suited for this operation. This makes this plane very useful during the *fix out* stage of a cottage.
The stock is made from machined metal and is available in lengths of 240mm, No.3, 245mm, No.4, to 260mm, No.4½. The cutting iron is 45mm to 60mm wide and fitted with a cap iron and a back iron to curl the shavings.

Fig. 61 Smoothing plane

Bench planes in use

The following steps outline the process of converting a piece of rough sawn timber into a finished piece, dressed-all-round (D.A.R.), highlighting the blade shape and cut made at each step.

STEP 1

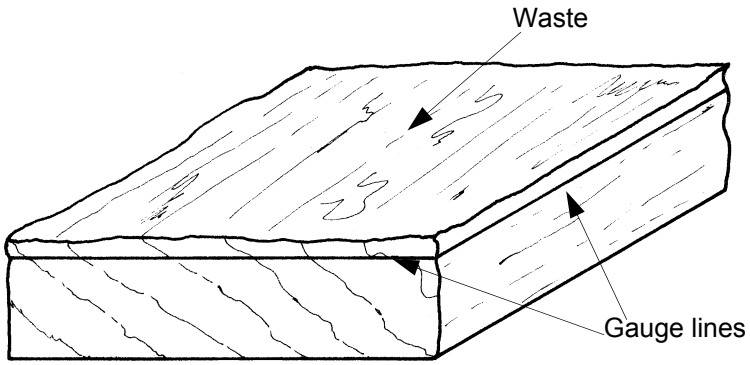

Fig. 62 Start with a piece of rough sawn (R.S.) timber

STEP 2

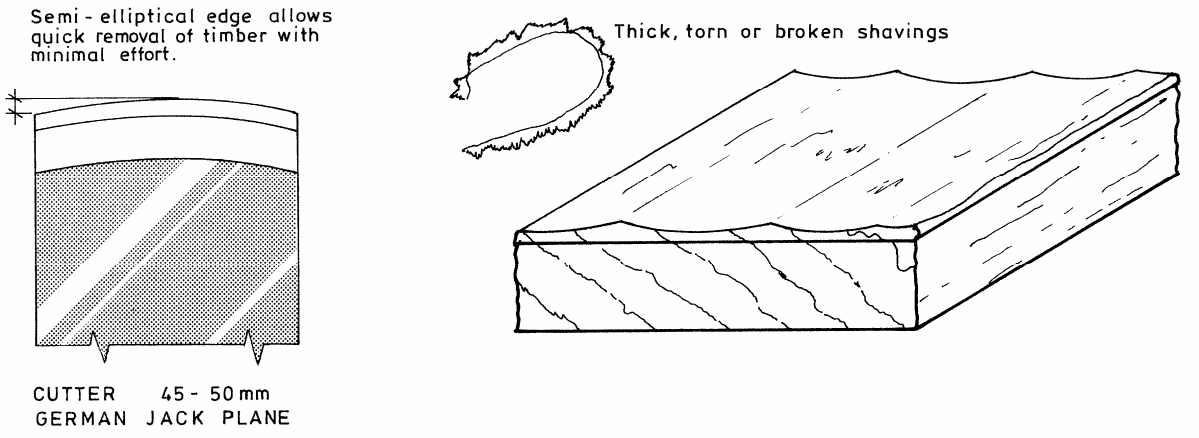

Fig. 63 Roughly planed with the German jack

STEP 3

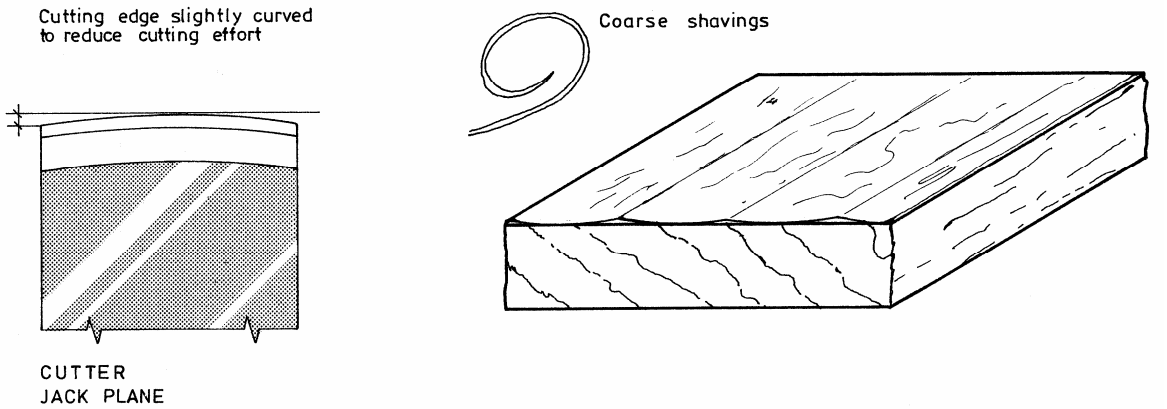

Fig. 64 Slightly uneven surface produced by a jack plane

STEP 4

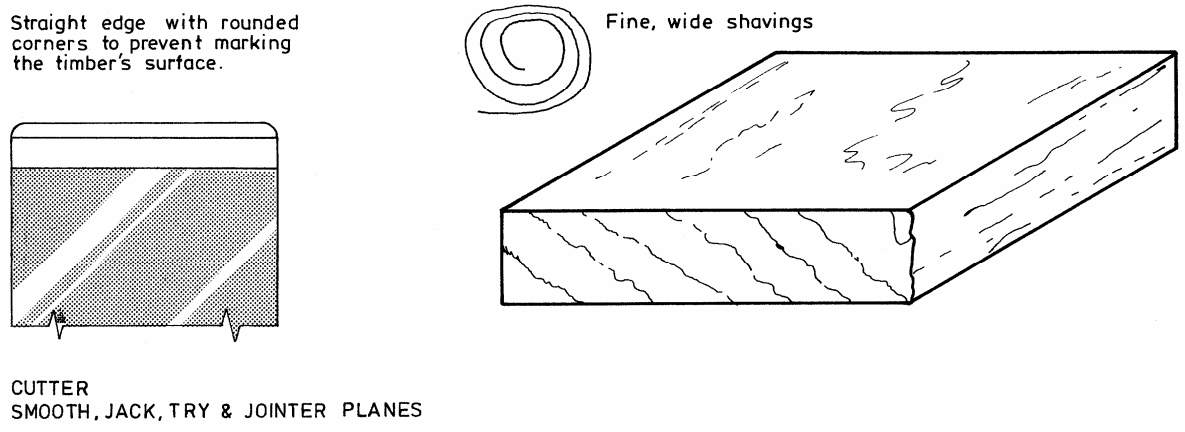

Fig. 65 Even surface produced with the use of trying and smoothing planes

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PLANING

To achieve the best results and finish, ie. to avoid tearing the grain, planing is carried out in the direction of the grain or *with-the-grain*.

When planing *against-the-grain*, or partly so where interlocked or *cranky grain* is encountered, the forward movement forces the shaving to run up the face of the cutting iron and split in advance of the cutting edge. This will occur even though there is a back iron in place. This split or *tear* extends into and below the surface of the timber beyond the reach of the iron. A series of these tears leaves a rough surface indicating that planing against-the-grain has occurred. The simple solution is to plane in the opposite direction but this may not always be possible, therefore the tearing may be minimised by using a fine mouthed plane with its back iron set close to the cutting edge of the cutting iron.

Holding the plane correctly

The plane should be held firmly with both hands, one on the handle at the heel end and the other on the knob at the toe end. With the elbows held in a rigid position the plane is pushed forward, using the persons body weight, by transferring the weight from the back foot to the front foot in one smooth motion.

Fig. 66 Planing technique

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Shooting the end grain

This is carried out on the end of the timber using a block or smoothing plane. The timber is placed very low in a vice, at 90° to the bench, with a piece of scrap timber placed in front of the edge furthest from the operator to prevent the edge being chipped off as the plane passes over it. The scrap piece is set approx. 0.5 to 1mm below the finished pencil mark and with only a minimum of very sharp plane blade exposed short firm strokes away from the operator are used to shave off the waste down to the mark. The end of the timber should be checked for square at regular intervals to ensure a square finished product.

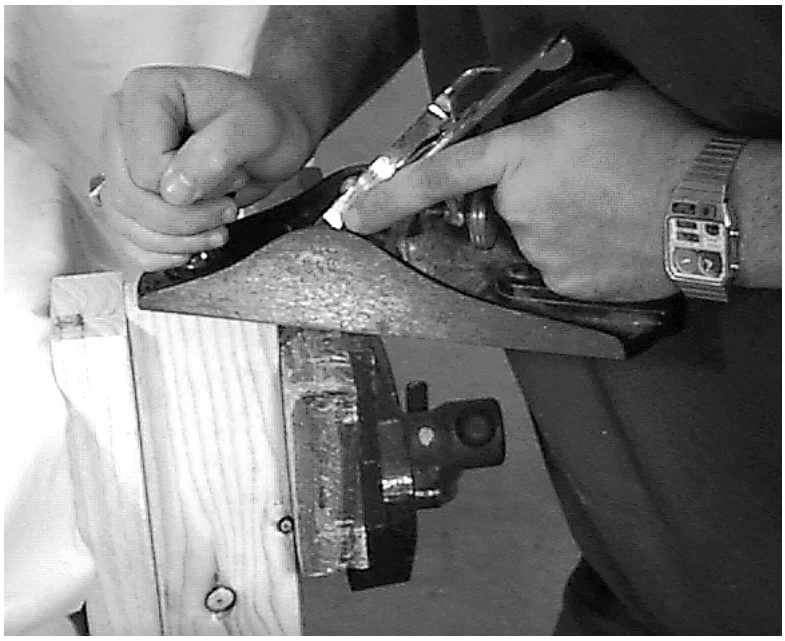

Fig. 67 Shooting the end grain

Importance of a close mouth

A *close mouth* is one which is considered to leave sufficient room only for the shavings to pass through freely. If a wide mouth is present, or if there was no solid portion of sole in front of the mouth, the tendency is for the fibres in front of the mouth to split up due to little or nothing to hold them down.

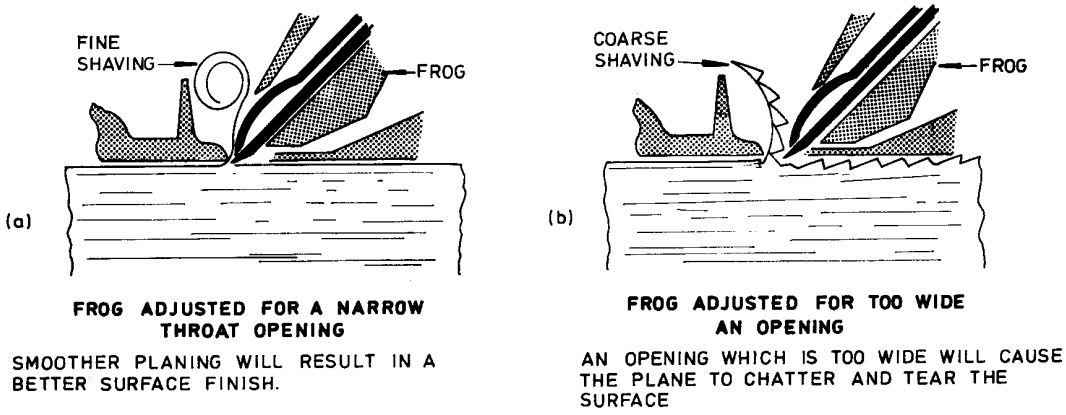

Fig. 68 Result of having a close or wide mouth

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Importance of a Back iron

It is essential that the back iron fits tightly on the face of the cutting iron otherwise shavings will be forced between the two irons causing the mouth to *choke* or clog up, which will not allow the plane to cut. The curved face of the back iron must be smooth to allow shavings to freely pass over it. The fit should be such that no light can be seen through the meeting point. To achieve this, it is necessary to file the back iron straight, then hone it to a fine edge before screwing the two irons together.

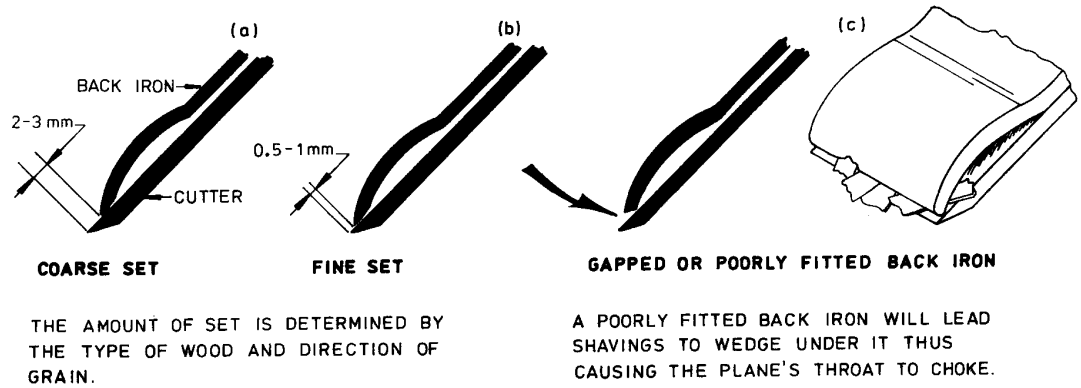

Fig. 69 Fitting the Back iron

Adjustment prior to use

The position of the back iron depends on the end use of the plane, the type of plane and the material being planed. Generally the distance from the cutting edge to the back iron would be as shown in table 1.3 below:

Table 3
Back Iron Position

PLANE	METRIC (mm)	IMPERIAL (inches)
Jack	2 to 4	1/16 to 5/32
Trying	1 to 2	1/32 to 1/16
Smoothing	0.5 to 1	1/64 to 1/32

To avoid angled cutting or 'gouging' of the planed surface, the cutting edge must project parallel to the sole of the plane. This adjustment is carried out using the *lateral adjusting lever* which is found under the blade just above the top of the plane handle. When moved side to side it will allow the blade to be move to the correct position, when viewed from underneath while holding the plane towards the light.

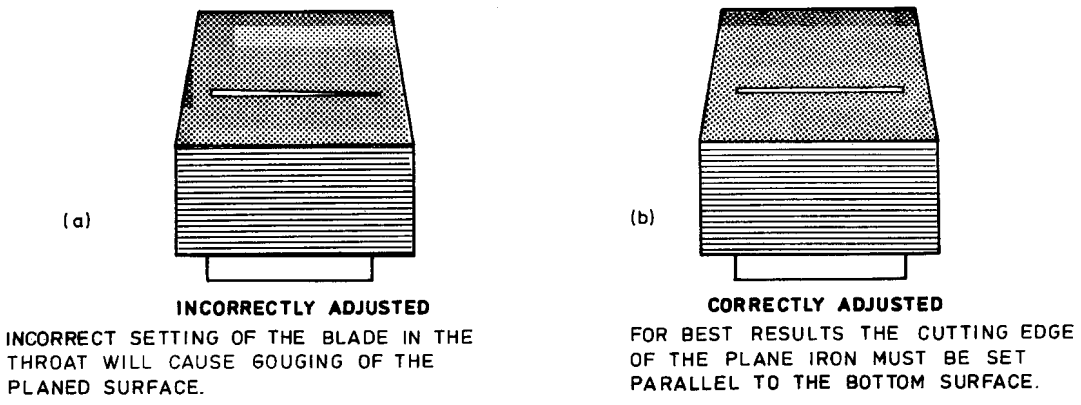

Fig. 70 Plane blade adjustment

MAINTENANCE OF CHISEL AND PLANE BLADES

Grinders

High revolution bench or floor stand electric grinders are the most commonly used machines to form the first angle on chisel and plane blades. Newer slow revolution 'water grinders' are now available and produce a clean ground edge with the minimum of effort, no hot metal sparks and no risk of raising the *temper* of the blade metal, which leads to weakness.
The blades should comply with the following during and after grinding:

- be ground at an angle of approx. 20 to 25° to the face
- be ground at right angles to the edge
- show only one continuous bevel
- not to be overheated or have the temper raised, ie. when the colour of the blade turns a blue/ black colour, which makes the metal brittle causing the cutting edge to gap and dull easily.

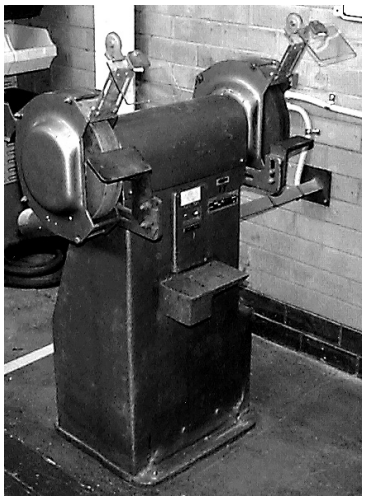

Fig. 71 Pedestal grinder

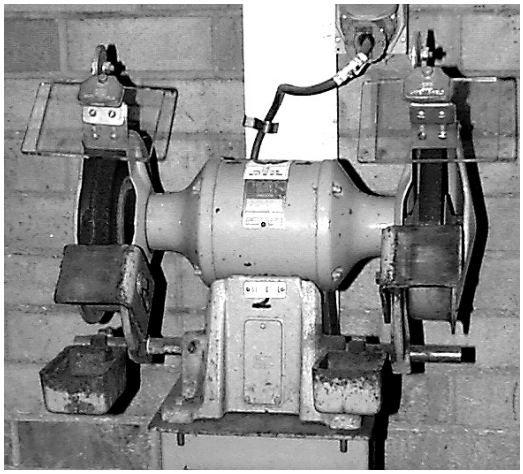

Fig. 72 Bench grinder

Grinding angle

The angle created by the grinder should be 20° to 25° or 2.5T, when 'T'= the thickness of the blade.

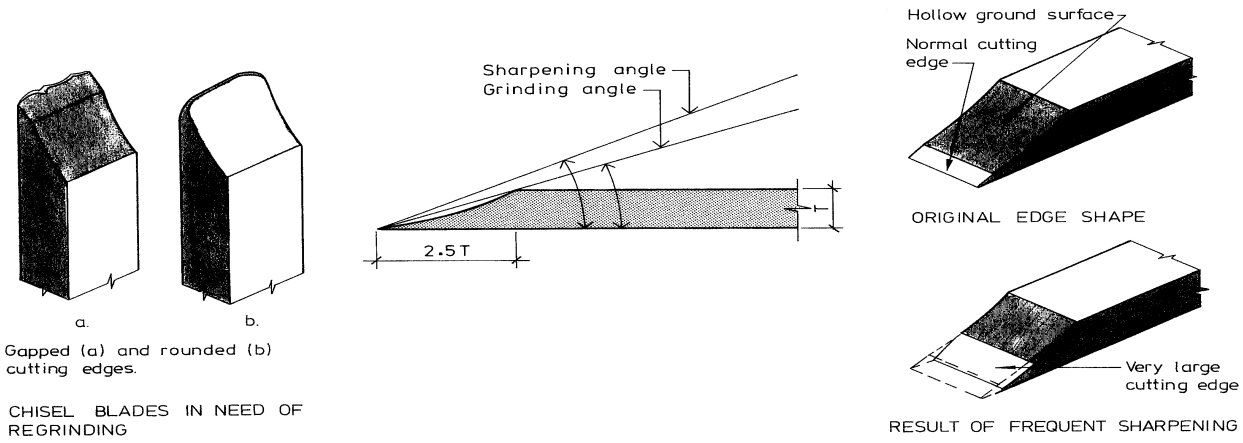

Fig. 73 Grinding angle

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Grinder Abrasive wheels

The following details are based on typical abrasive wheel markings:

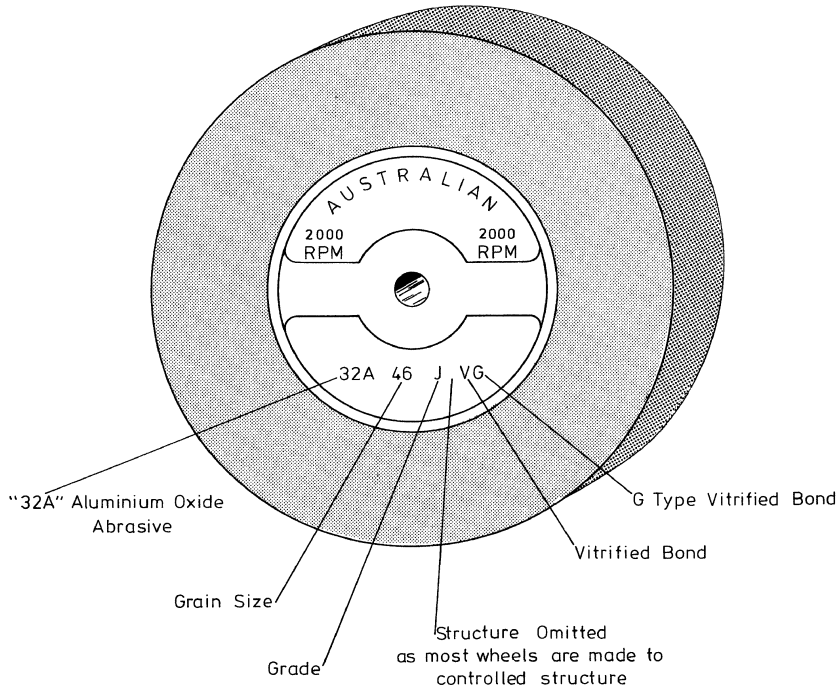

Fig. 74 Typical Australian abrasive wheel and specification

MATERIAL		
19 Aluminium oxide	=	19A
18 Aluminium oxide	=	18A
32 Aluminium oxide	=	32A
37 Silicon Carbide	=	37C
39 Silicon Carbide	=	39C
A and 37 mixture	=	AC

COARSE TO VERY FINE			
10	30	80	220
12	36	90	240
14	46	100	280
16	54	120	320
20	60	150	400
24	70	180	500

SOFT TO VERY HARD			
E	J	O	U
F	K	P	V
G	L	Q	W
H	N	R	X
I	M	S	Y
		T	Z

V = Vitrified Aluminium Oxide Products		
V	=	Regular Vitrified
VBE	=	"BE" Type Vitrified
VG	=	"G" Type Vitrified
VBA	=	"BA" Type Vitrified
Silicon Carbide Products		
V	=	Regular Vitrified
VK	=	"K" Type Vitrified
Aluminium Oxide and Silicon Carbide Products		
E	=	Shellac
E6	=	"6" Type Shellac

B = Resinoid Aluminium Oxide and Silicon Carbide Products		
B	=	Regular Resinoid
B2	=	"2" Type Resinoid
B7	=	"7" Type Resinoid
B11	=	"11" Type Resinoid
B12	=	"12" Type Resinoid
B14	=	"14" Type Resinoid
BDA	=	Resinoid reinforced Raised Hub
BNA	=	Resinoid Reinforced Straight

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ABRASIVE WHEELS - DEFINITIONS

Grinding

This is the cutting action of thousands of sharp abrasive grains on the face of the grinding wheel,which actually chip out the waste.

Components

A grinding wheel has two components - 'abrasive', which does the actual cutting and 'bond', which supports the abrasive grains while they cut. Together they combine to form a characteristic known as structure.

Abrasives

Aluminium Oxide is made from bauxite (a clay-like material) mixed with ground coke and iron filings, burnt for 15 to 25 hours at 720°C in electric furnaces - for grinding materials with a high tensile strength.
Silicon Carbide is manufactured by the chemical interaction of silicon, sand and coke in electric furnaces at temperatures of over 950°C - for grinding materials of a low tensile strength.

Grain size

Represents the number of openings per 25mm linear length in one of the screens used to size the grain.

Grade

Represents the hardness, ie. strength of bonding. In general, it is the amount of bond which determines the hardness of the wheel. Grading is from A to Z, ie. soft to hard.

Structure

This describes the grain spacing in a wheel and is determined by the proportion and arrangement of the abrasive and bond. The structure number indicates the grain spacing in a wheel. When the abrasive grains are close together, relative to their size, the wheel has a dense structure as indicated by a lower structure number such as 4 or 5.

Bonds

There are 6 types used for grinding wheels as follows:
Vitrified, or ceramic, are made from clays and felspar. 70% of wheels are made from this bond as the porosity and strength give high stock removal and they are unaffected by water, acids, oils or temperature variation.
Resinoid wheels are made from resin and are used for high speed wheels of up to 9,500rpm.
Shellac wheels are used for roll grinding and other cylindrical operations.
Rubber, silicate and *magnesite* wheels are imported wheels.

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GRINDER SAFETY

	DO
1.	Always handle and store wheels in a careful manner
2.	Visually inspect all wheels before mounting, to check for possible damage during transit.
3.	Check the Maximum operating speed established for wheel against machine speed.
4.	Check mounting flanges for equal and correct diameters. They should be at least one-third of the wheel diameter and relieved around the wheel mounting hole.
5.	Always use mounting blotters supplied with the wheels
6.	Be sure the work rest is properly adjusted. This should be set at the centre of the wheel and no more than 25mm away.
7.	Always use a guard covering at least one half of the grinding wheel
8.	Allow the newly mounted wheel to run at operating speed , with the guard in place, for at least one minute before grinding.
9.	Always wear safety glasses or some type of eye protection when grinding.
10.	Do not turn off coolant before stopping the wheel to avoid creating an out-of-balance condition.

	DON'T
1.	Never use a wheel that has been dropped.
2.	Never force a wheel onto the machine or alter the size of the mounting hole - if the wheel won't fit the spindle then get one that will.
3.	Never exceed the Maximum operating speed established for the wheel.
4.	Never use mounting flanges on which the bearing surfaces are not clean and flat.
5.	Never tighten the mounting wheel nut excessively.
6.	Never grind on the side of the wheel unless the wheel is specifically designed for this purpose.
7.	Never start the machine until the guard is in place.
8.	Never jam the work into the wheel.
9.	Never stand directly in front of a grinding wheel when it is first started up.
10.	Never grind material for which the wheel is not designed.

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OILSTONES - MANUFACTURE, CARE AND USE

Manufacture

Oilstones may be divided into two main groups;
1. Natural stone
2. Artificial stone

Natural stone

These are imported with the 'Norton Washita' being the most common. It is white in colour and is very durable.

Artificial stone

These have two main components;
1. Abrasive - which does the actual cutting
2. Bond - which supports the abrasive grains while they cut.

The arrangement of these two components gives a definite characteristic known as 'Structure'.
Most stones are made from;
1. Aluminium Oxide
2. Silicon Carbide

These stones are usually available in three grades;
1. Fine
2. Medium
3. Coarse

With some stones having a fine and a coarse side to them, ie. half and half.

Care of the Stone

Stones should always be kept in a box or case to protect the stone from both careless handling and from dust settling on the surface, which will lead to clogging. When placed in a box, the base should be recessed and perfectly flat on the bottom to prevent the stone from breaking when pressure is applied during sharpening. Small blocks of hardwood may be set at both ends of the stone, flush with the top, so the blades may be passed over the full length and width of the stone to prevent uneven wear of the surface.

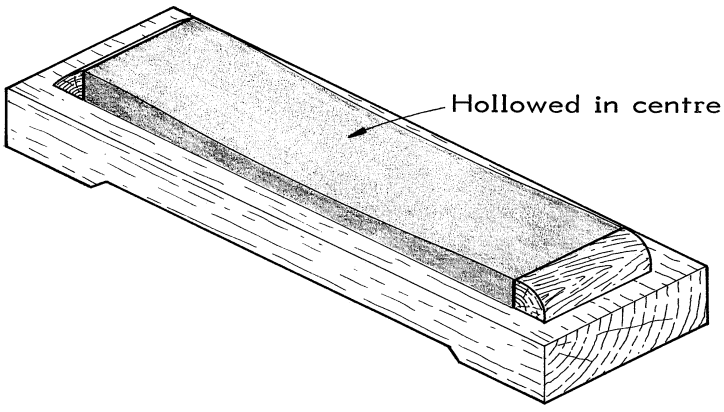

Fig. 75 Oilstone showing uneven wear and flush blocks

The stone may require 'rubbing down' after prolonged use to ensure the surface remains flat. This surface grinding may be achieved by rubbing the stone over an old plate glass surface using carborundum powder as the cutting abrasive.

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Surface lubricant

To avoid clogging the stone and to reduce friction, a non-drying oil such as 'Neatsfoot' must be used. This is basically an animal fat and it has a tendency to congeal during cold weather, therefore it may require thinning by the use of kerosene. The oil allows the fine metal filings to float and only a small amount is required to prevent the grain of the abrasive from clogging, which would render the stone useless.

The stone should always be primed with oil when new, wiped clean after every use and be kept covered when not in use.

Honing or Whetting blades

This is the process of sharpening the ground end of a plane or chisel blade to a fine cutting edge. The term *whetting* refers to the *act of sharpening*, hence the use of a *whetstone* for sharpening the blades of tools and knives.

The following steps outline the procedure involved when sharpening tool blades:

STEP 1 After the plane or chisel blade has been ground to the desired angle, ie. 20° to 25°, and the oilstone has been prepared, place the blade on the stone so the ground face is in full contact with it. Holding the blade firmly with both hands lift the back of the blade up very slightly, ie. approx. 5°, which will give a honing angle of around 25° to 30°, then push forward using your body weight with a *figure-8* or a *circular* motion while maintaining a constant angle between the blade and the stone. Use the full length and width of the stone for this operation to avoid uneven wearing of the stone's surface.

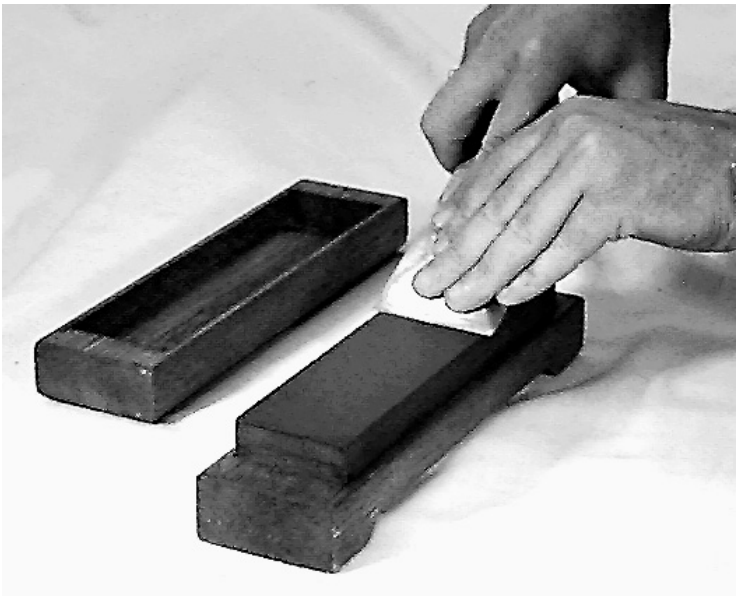

Fig. 76 Honing the blade

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STEP 2 Once the blade has an evenly honed edge it will require removal of the slight *'burr',* which will be present on the opposite side. To remove this burr, turn the blade over and hold it hard down and flat onto the stone. Using a similar figure-8 or circular motion, remove the burr from the flat side.
Note: *Under no circumstances should there be an angle on the back flat side*.

Fig. 77 Removing the burr from the back of the blade

STEP 3 The final step is to *strop* the blade to remove any remaining burr or sliver of metal, which may be still hanging off the cutting edge. This is done by stroking the blade backwards and forwards, very carefully, across the top of the palm of the hand as shown below.

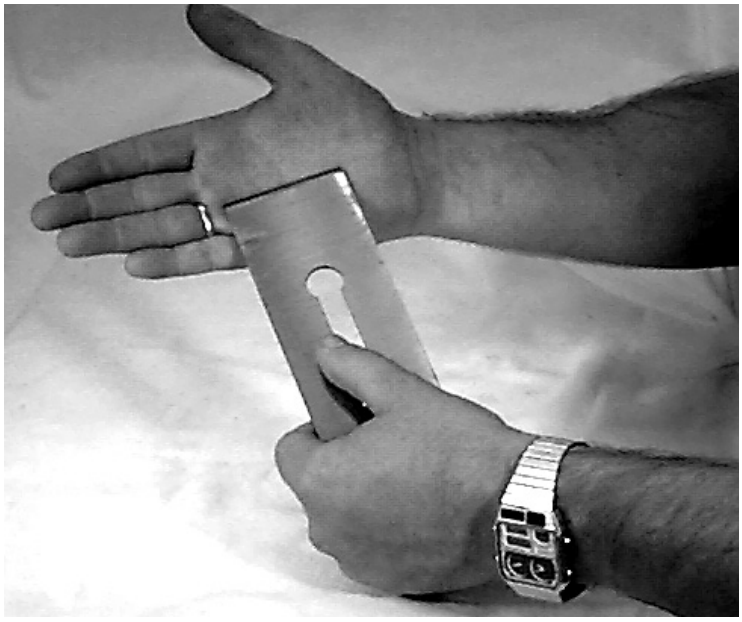

Fig. 78 Stropping the blade

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